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ABSTRACT

This evaluation report focuses on a broad range of issues associated with the work of the Electronic Text Consortium (consisting of San Diego State University, University of Wisconsin, University of Nebraska, and WGBH Boston), whose year-long task was to develop and test a variety of electronic text services and to assess which configurations of content and means of delivery, if any, made sense for higher education. Based on field and laboratory tests, national surveys of college administrators and electronic text managers, and direct observational studies of students using the services, the consortium's evaluation addressed issues of learning effectiveness, attractiveness to students, usage patterns, economic issues, likely adoption patterns by students and colleges, potential barriers, and sturdiness of the technology. This report is divided into six chapters: (1) a general introduction and overview; (2) results of the field tests; (3) results from the formative and simulation laboratory studies; (4) issues associated with the potential for widespread use of electronic text by colleges, including barriers to use, economic issues, and results of a survey of colleges on current and planned uses for electronic text; (5) the practical questions of where the technology stands and the problems associated with developing services, as well as staff and training requirements for an electronic text production team; and (6) conclusions based upon an examination of all the individual pieces in the evaluation. A brief appendix provides a list of consortium members, addresses, and contact persons, as well as a list of consortium publications. (JB)

Electronic Text Consortium

Electronic Text for Higher Education

San Diego State University, University of Wisconsin, University of Nebraska, WGBH Boston

ED259724

ASSESSING ELECTRONIC TEXT FOR HIGHER EDUCATION: EVALUATION RESULTS FROM LABORATORY AND FIELD TESTS

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ASSESSING ELECTRONIC TEXT FOR HIGHER EDUCATION: EVALUATION RESULTS FROM LABORATORY AND FIELD TESTS

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EXECUTIVE SUMMARY

This evaluation report focuses upon a broad range of issues associated with the work of the Electronic Text Consortium. The purpose of this year-long effort was to develop and test a variety of electronic text services and to assess which configurations of content and means of delivery, if any, make sense for higher education. The evaluation addressed issues of learning effectiveness, attractiveness to students, usage patterns, economic issues, likely adoption patterns by students and colleges, potential barriers, and robustness of the technology. With some qualifications to be noted below, the results are positive and very encouraging.

In order to tackle the broad set of questions in our evaluation agenda, we employed a few complementary paths of research, including laboratory and field studies, national surveys of college administrators and electronic text managers, and direct observational studies of students using the services as well as assessments of the technology itself and economic issues associated with electronic text.

Field testing in Massachusetts, Nebraska and Wisconsin consisted of a mini-semester 3 to 7 weeks in length embedded within a course or running parallel to one. Student groups using electronic text achieved higher test scores than control groups without electronic text (or, improved scores over pre-treatment measures of knowledge) in the following modes of electronic text use: as an enhancement to a telecourse; as a stand-alone correspondence course; and, as a remedial tool to improve math skills. All of these results were statistically significant. In addition, a student group using electronic text as a supplement to classroom instruction achieved higher test scores than a control group without electronic text, though the results were not statistically significant. Electronic text did not yield higher test scores when it was used as a substitute for a classroom instructor.

In our surveys of students who participated in the field testing, we attempted to establish a baseline of existing media habits and attitudes about technology as well as existing study habits and communication patterns with instructors. Among the more important findings were somewhat greater ownership of personal computers (15 percent of students) compared to the general population; easy access to a personal computer by an additional 33 percent of students; and an intention to purchase a personal computer in the next few years by 34 percent of the students surveyed. The adoption of personal computers is an important prerequisite for the growth of electronic text. In addition, the baseline survey questions revealed a need for more communication

between students and instructors, and easier access to library resources. Both are potential electronic text services. Student attitudes about new technology in education were positive with an important qualification: students want to know that the technology will bring some instructional benefits with its use. Responses to the baseline questions suggest a general "readiness" to use electronic text and some needs for it.

An examination of how students used the electronic text services indicated relatively few technical problems or difficulties in achieving comfort working at the terminal. There is an important qualification here. It is crucial that some form of assistance (e.g., a lab assistant or a person who can be telephoned) be available to students during the early phases of learning how to use electronic text.

There were some indications that usage sessions longer than one hour may lead to eye strain or fatigue. Also, students who used the services at home appeared to enjoy some advantages over on-campus users. In particular, they took advantage of the greater flexibility in hours of use at home, e.g., early morning and late at night as well as on weekends.

In general, students liked the electronic text services. More specifically, they gave high ratings to the graphics, the quality of the interaction, ease of use, realism of the simulations and what they learned. Students were critical of the slow display time in one of the services and generally wanted more flexibility or control over how they used the content (e.g. go backwards or skip around the material at will). After using the electronic text, students indicated an interest in future services that offered course content, access to national databases, course registration and access to campus-based information such as the library card catalogue. They indicated further that electronic text could serve their needs by providing self-paced learning, learning at home, supplements to classroom instruction and access to information beyond their campus. Above all, students want high quality content to meet instructional needs.

Our laboratory studies placed an emphasis on elements that are likely to increase or decrease the adoption of electronic text by students. A few important patterns emerged. First, the presence of graphics in a system significantly increased projected adoption by students. Second, there is a linear relationship between the number of electronic text services offered and projected adoption.

This suggests that a "critical mass" of services may be required to induce widespread adoption by students. Third, and perhaps most important, the laboratory studies indicated a positive relationship between the distance a student lives from campus and his or her likely adoption of electronic text. At the same time, there was a negative relationship between age and projected adoption, i.e., older students are less likely to adopt electronic text. Since a distant learner is often an older student, the two relationships might cancel each other out. However, the laboratory studies indicated that live demonstrations of electronic text services are an effective way to overcome the hesitation of some older students.

A survey of 94 colleges found a general "preparedness" for electronic text services, in that all the colleges have word processing and some computing capability; and a majority have some form of electronic mail as well as self-paced instruction. It appears that very few colleges have yet begun to offer the types of electronic text services developed by the Consortium members in this project. However, 45 percent of the surveyed colleges indicated that they have given some consideration to electronic text services. The types of services for which they see the most practical applications of electronic text include instruction, course registration assistance and student information services. The college administrators responding to our survey stressed that electronic text should be used selectively and appropriately, e.g., for self-paced learning, and that it must be designed in a "user friendly" manner. When asked about concerns, they cited cost and the potential that electronic text might reduce instructor-student interaction. Above all, the survey revealed much uncertainty about what electronic text services are and how they can be used.

Three general issues emerged from our economic assessment of electronic text. First, telephone transmission costs are critical to the viability of an electronic text service such as videotex. The telephone rate structure in a given location and the distance of students from the host computer can render a service economically viable or not viable. There are a few ways to reduce telephone costs, e.g., use of services in non-peak hours, downloading, and publishing some content directly on floppy diskettes. Second, it appears that an adapted personal computer offers many advantages over a dedicated terminal as the receiving equipment for electronic text. Third, there is much variability in the cost of a host computer for an electronic text system operator. Low and mid range systems appear to be more viable for a college or other higher education institution. Our economic assessment also suggested a value in local electronic text services, particularly

in the near term, as a way to keep costs manageable.

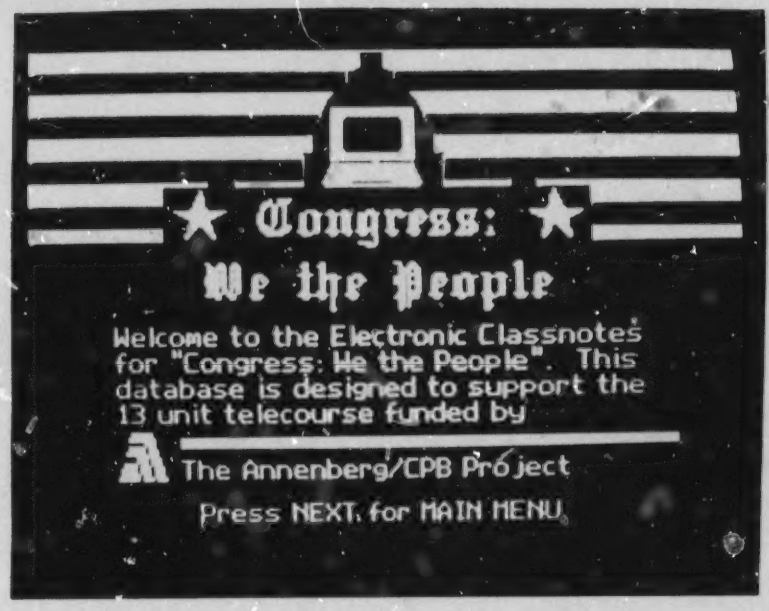
Three potential barriers to electronic text are addressed in this report. First, there have been many reports about lower levels of interest in personal computers by women compared to men. One national survey of households with a personal computer found that males used the computer more than females by a ratio of 3:1. Our field evaluation indicated that women used the electronic text as much or more than males and that they rated it a degree or two higher than males. At the same time, the women students in our field evaluation owned far fewer personal computers compared to male students and the percentage of women planning to purchase a personal computer is far lower. Our research by no means resolves the issues associated with women and their use of computers, but it does provide some clues about relevant factors affecting usage and attitudes. These include the gender of those who create software (85 percent male in commercial software production; strong female representation in Consortium software production), role models and advertising (commercial advertising emphasizes males; at least one principal person introducing electronic text at the evaluation sites was female), and functionality (female respondents to our survey were strongly interested in services that had a clear function in their education and had a low interest in playing with the technology for its own sake). A second potential barrier is faculty resistance. Our field evaluation encountered little faculty resistance, though some indicated that there might be resistance from other faculty members. Introducing the technology to faculty with a minimum of hyperbole and describing it simply as another tool for students and instructors appeared to receive positive reactions. Further, few faculty seemed to believe that electronic text might replace their job. A third potential barrier is associated with implementation of new electronic text services. We encountered some problems in one location when there was little assistance for students after an initial training session. In addition, there was low usage at one site where the time for accessing the terminal was restricted. These and other implementation issues require attention if electronic text is to be adopted widely.

Our technology assessment reviews several issues that point to the value of a local college or regional consortium operating its own electronic text service, particularly in the near term. At a local level, a college can operate as a "closed user group" and thus control all of the elements necessary for a viable service. The technology assessment also points to a need for more and better host computer software packages that will enable colleges to operate low and mid range electronic text services.

The report concludes with a general positive assessment of electronic text as a tool for higher education. The evaluation results indicate that electronic text can be effective as a learning tool. Further, students appear to have a positive reaction to the services and many have the necessary hardware (or easy access to the hardware) to be able to make use of electronic text. In providing such services, a strong emphasis should be placed on quality of the instructional content and functionality - how electronic text can serve student needs. At the same time, it is important to control costs and therefore prices of services for students. To support this goal, there are many indicators pointing to the value of a college operating its own system. For this to occur, there is a need more and better host software packages (or, new configurations of existing software). Further, there is a general need for colleges to better understand what electronic text is, how it can serve students, and the steps necessary to develop local services.

From Electronic Classnotes to support CONGRESS: WE THE PEOPLE telecourse.

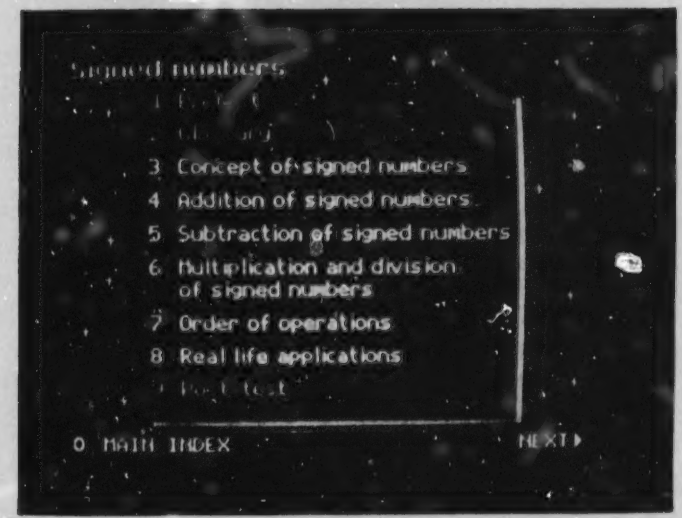
Center for Communications
San Diego State University


Congress:
We the People
Welcome to the Electronic Classnotes for "Congress: We the People". This database is designed to support the 13 unit telecourse funded by
The Annenberg/CPB Project
Press NEXT for MAIN MENU

A University of Wisconsin student accessing electronic text lessons

From Mastering Math Skills

WGBH Boston


3 Concept of signed numbers
4 Addition of signed numbers
5 Subtraction of signed numbers
6 Multiplication and division of signed numbers
7 Order of operations
8 Real life applications
0 MAIN INDEX
NEXT

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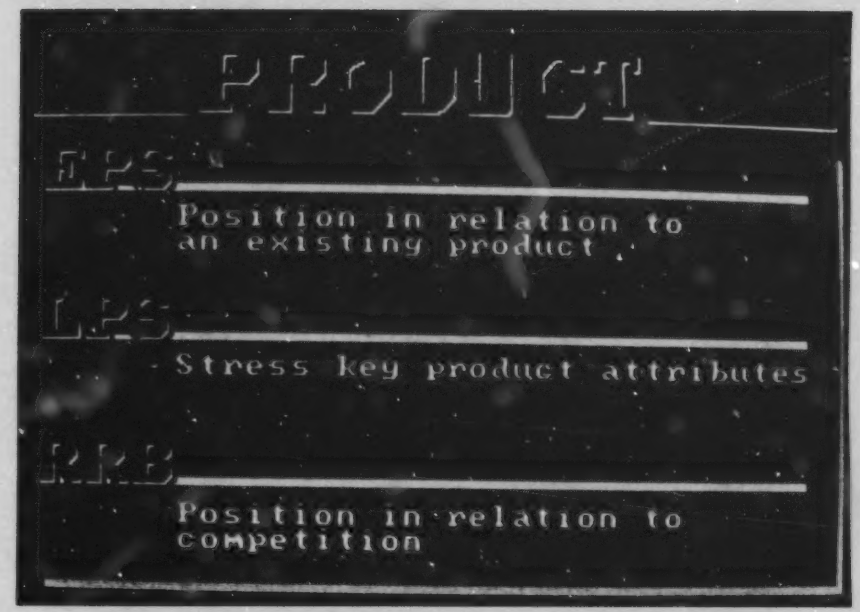
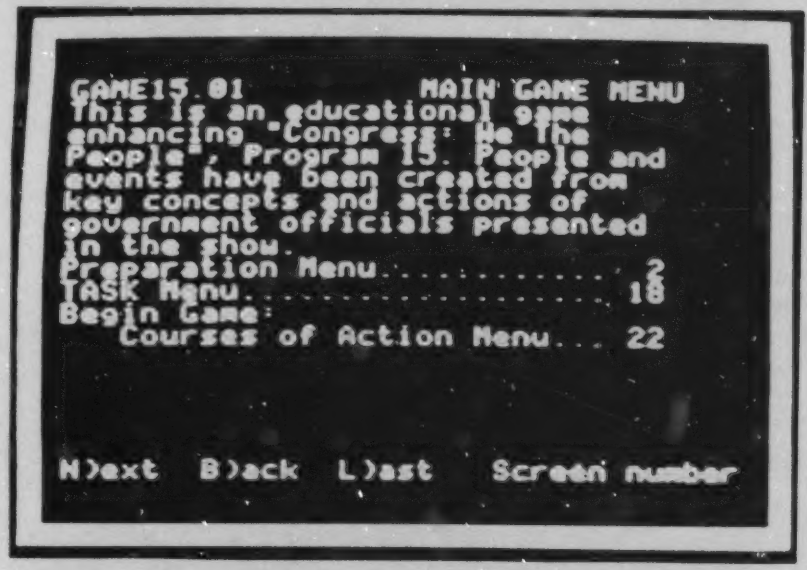
From Introduction To Marketing.

KUON TV, University of Nebraska-Lincoln


PRODUCT
Position in relation to an existing product
Stress key product attributes
Position in relation to competition

From Interactive Simulations to enhance CONGRESS: WE THE PEOPLE telecourse.

University of Wisconsin-Extension


GAME15.01 MAIN GAME MENU
This is an educational game enhancing "Congress: We The People", Program 15. People and events have been created from key concepts and actions of government officials presented in the show.
Preparation Menu..... 2
TASK Menu..... 18
Begin Game:
Courses of Action Menu... 22
N)ext B)ack L)ast Screen number

From Electronic Course Catalogue used in Simulation Lab Studies

Center for Communications San Diego State University

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1. INTRODUCTION

This report presents the findings of a year-long evaluation effort focused upon the work of the Electronic Text Consortium. The Consortium consists of San Diego State University, University of Wisconsin, University of Nebraska and WGBH Boston. Support for the Consortium and the evaluation has been provided by the Annenberg/CPB Project. However, any opinions or interpretations of data presented in this report are the sole responsibility of the principal authors.

The term "electronic text," as used here, is a generic reference to print and graphical information that is displayed on a computer-based terminal or decoder. This information may be transmitted in several ways, including telephone lines, cable television and broadcast signals, as well as stored on floppy diskettes. Thus, electronic text encompasses a family of services that are commonly called videotex, teletext, cabletext and telesoftware. The bulk of the work of the Electronic Text Consortium in its first year was associated with videotex.

In broad terms, the purpose of the evaluation was to assess how electronic text might serve the needs of higher education. That is, given all the complexity surrounding electronic text in its many forms, what makes sense for the delivery of education to college students; where are the strong opportunities, particularly for the nontraditional learner; and what are the barriers to development? In order to support this general set of goals, the evaluation focused upon the following questions:

- Can electronic text be used to communicate instructional materials effectively and yield measurable learning outcomes?
- What characteristics are associated with alternative forms of electronic text and ways of using it?
- What types of students are likely to use electronic text and what types are weak candidates to adopt it?
- Are colleges ready, willing and able to make use of electronic text?
- What is the current state of electronic text technology and where is it heading?
- Are the costs of electronic text production, transmission and user terminals acceptable?
- How can a college or other higher education group get started in electronic text; what are the associated staffing and training requirements?

In order to tackle these and many related questions, we launched a robust evaluation program that included two national surveys, field testing of instructional materials on-campus and in student homes, and laboratory studies. Specifically, the evaluation components included: the creation and field testing of electronic text course materials at five sites; formative laboratory testing of graphics and instructional design issues; a national survey of colleges, dealing with their current and planned uses for electronic text; a survey of electronic text managers in the commercial and education sectors, dealing with staff and training needs for electronic text production; an economic assessment of equipment, transmission and end-user costs; simulation laboratory studies of projected student adoption patterns; and, a technical assessment of current and anticipated electronic text technology. This report touches upon each of

these evaluation components, with an emphasis upon our field testing and simulation laboratory studies.

It was our intention from the beginning of the project to publish evaluation results as soon as they became available. Toward this end, the Consortium has issued seven reports and one monograph prior to this report (see Appendix for a complete list of publications). Some of the results presented here in brief form, e.g., economic issues associated with electronic text, are reported more completely in other publications of the Consortium.

The activities of the Consortium members that are treated in this report include the following:

- Center for Communications, San Diego State University. Developed electronic text materials to enhance the broadcast telecourse, CONGRESS: We The People; developed electronic class notes and other information services for a San Diego State mechanical engineering course; conducted formative and simulation laboratory studies.

- University of Wisconsin-Extension, Telecommunications Division. Developed electronic text simulations, extended text readings and mini-databases to accompany the broadcast telecourse, CONGRESS: We The People; tested electronic mail and computer conferencing among students and professors; developed educational computer simulation game, "Campaign For Congress."

- KUON-TV, University of Nebraska-Lincoln. Developed an electronic text independent study course, "Introduction To Marketing." Each lesson in the stand-alone course consists of a syllabus and text materials, interactive simulation/tutorial and self-check test.

- WGBH Educational Foundation. Developed electronic text instructional lessons to teach basic math skills to post-secondary students. The interactive course tutorials, "Mastering Math Skills", provide online quizzes and instruction as well as offline paper-and-pencil work for students.

Together, the Consortium members created materials for a broad range of graphics' standards, host systems and display terminals: from black and white ASCII text with no graphics to full NAPLPS color graphics with animation; from a stand-alone personal computer host system to a large commercial videotex system; and, from a low-end $175 videotex terminal to a high-end personal computer adapted to receive videotex. They created and tested a sufficient range of electronic text options for the evaluation team to be able to systematically address the research questions outlined earlier.

The report is organized in a straightforward manner. Chapter 2 describes the results of the field tests. Chapter 3 presents results from the formative and simulation laboratory studies. Chapter 4 treats a series of issues associated with the potential for widespread use of electronic text by colleges, including barriers to use, economic issues and results of a survey of colleges on current and planned uses for electronic text. Chapter 5 examines the practical questions of where the technology stands and the problems associated with developing services, as well as staff and training requirements for an electronic text production team. Chapter 6 presents conclusions based upon an examination of all the individual pieces in the evaluation. A brief appendix section to the report provides a list of Consortium members, addresses and contact persons as well as a list of Consortium publications.

2. FIELD EVALUATION

Our program of field evaluation addressed several basic questions, including: was electronic text an effective educational tool; how was it used by students in their homes as well as on the college campus; did students find it attractive and useful; were any unique effects, core strengths or weaknesses associated with electronic text; and, are students ready, willing and able to integrate electronic text into their studies? The field evaluation efforts complemented a program of laboratory studies described in chapter 3 of this report.

Field evaluations were conducted between September 1984 and March 1985 at 5 sites: Boston, Massachusetts; Greenbay, Wisconsin; Lincoln, Nebraska; San Diego, California; and Whitewater, Wisconsin. Approximately 325 students participated in the overall evaluation and approximately 200 students received electronic text instruction and were tested.*

In simple terms, the electronic text treatment at each site consisted of a mini-semester, 3 to 7 weeks in length, embedded within a regular course. Evaluation consisted of a questionnaire administered to students before and after receiving electronic text course instruction; a test administered after the electronic text instruction (where appropriate, students were pre-tested as well); on-site ethnographic recording of student behavior at

* The evaluation design is described more completely in John Carey, Research Design and Survey Instruments. San Diego: The Electronic Text Consortium, 1984.

some locations; and interviews with selected students and faculty.* There were many noteworthy differences at each site both in terms of the population of student users and the form of electronic text they received. These differences are described in relevant sections of this chapter as a textual commentary about tables of findings.

2.1 ESTABLISHING A BASELINE

In trying to come to grips with a new technology and to understand how it might serve higher education, it is useful to first establish a baseline of existing habits and attitudes.

The students who participated in our evaluation were typical of other college students in many of their media habits, while at variance from the general population in some habits. The students in our broad survey across test sites (N=292) read newspapers and magazines regularly (the average student in the survey read 1.1 newspapers and 1 magazine regularly). At the same time, they watch less television than the general population: a majority watch less than 2 hours per day during the regular semester. In addition, the students have more media available to them in their homes compared to the average American home. For example, 26 percent of the student households own a video-cassette recorder and 62 percent have cable television. These findings were reasonably consistent among the sites in our evaluation.

Ownership or easy access to a personal computer is an important requirement for the widespread use of electronic text.

* Test results reported here are from Boston, Greenbay, Lincoln and Whitewater. Some problems were encountered in the San Diego testing. These are described in chapter 4.

Our survey was quite revealing in this area: 15 percent of the students owned a personal computer and an additional 33 percent said that they had easy access to one. Of those who owned a personal computer, the average price paid for the computer and the peripheral equipment associated with it was $ 1,200. This is important in that it suggests that these students, or their parents, have purchased a computer which can support serious academic work. It is not merely a toy. In addition, 34 percent of the students indicated that they plan to purchase a personal computer in the next few years (some of these are planned first-time purchases of a computer while others are planned replacement purchases for an existing personal computer) and many others are unsure if they will purchase a personal computer. Of those who plan to purchase a personal computer, 100 percent expect to pay at least $1,000 for the computer and associated peripheral equipment. A conservative interpretation of these figures would suggest that one-third or more of college students are likely to own a personal computer in the next few years and that a strong majority will own or have easy access to one. Further, it is likely that these computers will be serious tools that can be used for electronic text course materials. However, it should also be noted that ownership of a personal computer was lower among female students (19 percent for males versus 9 percent for females) and that a lower percentage of women students plan to purchase a personal computer in the next few years (40 percent for males versus 26 percent for females).

We also sought to draw a map of selected skills, habits and attitudes of students that might reveal their "readiness" or "need" to use electronic text. The first of these is library usage. Table 1 outlines patterns of library use during the school year.*

Table 1. Student Library Usage

Amount of Use During School Year	Percentage of Students
Less Than Once A Month	12%
Once Or Twice A Month	34
Weekly	30
2-3 Times Per Week	15
Nearly Every Day	9
	100%

(N=284)

There were some noteworthy differences among the sites. In Nebraska, where the student group was quite representative of the Annenberg/CPB target population (i.e., adults in their mid 20s, many of whom are working while attending college part time) use of the library was lower: 80 percent of the student group reported that they use the library twice a month or less. It may be argued that easier access to library resources is needed, particularly by the non-traditional learner. It does not necessarily follow that when students are provided with easier access they will increase their use of library materials. However, Tables 8 and 19 will show that students have a strong interest in electronic

* It will be noted that some tables have a large N, indicating that the question was asked at all sites and some have a small N, indicating that the question was asked at selected sites. Characteristics of respondents, where relevant, will be described in the text.

text that can provide access to library resources.

A second baseline pattern involves student access to and communication with a course instructor. We asked students to estimate their communication with an instructor outside formal class time, i.e., informal discussion before and after class, private meetings during instructor office hours, telephone calls and notes or letters exchanged. Table 2 presents their estimates. It should be noted that our question asked for a broad approximation of communication in a "typical" course. A breakdown of communication patterns by type of course (e.g., seminar, small class and large lecture class) would be desirable.

Table 2. Student-Instructor Communication Patterns Outside Formal Class Time

Type of Communication	Estimate of Total Communication During a Full Semester
Face to Face (e.g. office visits & discussion before and after class)	50 minutes
Telephone Calls Between Student & Instructor	1.4 calls
Letters or Notes Exchanged	1 letter or note

(N=76)

Table 2 reveals a relatively low, though not surprising, amount of communication between students and instructors outside normal class time. The patterns may be broken down by groups: males reported twice as much communication with the instructor compared to females; and evening, adult students reported far less communication compared to on-campus day students. As in the

case of library usage, the existing patterns of student-instructor communications suggest a need for increased access to a course instructor, a need which electronic text might fulfill. Further, Tables 8 and 19 will show a moderate to strong interest by students in such communication via electronic text.

If communication with an instructor and easier access to library resources are potential needs that might be met, in part, by electronic text, then typing skills represent a potential barrier. Table 3 presents another important baseline pattern: student estimates of their typing skills.

Table 3. Student Estimates of Their Typing Skills

Level of Skill	Percentage of Students
Can't Type at All	10%
Minimal (Can type a letter or memo but anything longer would be a problem).	23
Moderate (Can type term papers and other documents with acceptable speed for personal needs).	42
Very Good (Could get a job that required strong typing skills).	25
(N=69)	100%

In general, the reported levels of typing skill are sufficient for most applications of electronic text. A minimal level of skill as defined in Table 3 will suffice for selecting information, answering multiple choice or short open-ended questions and sending electronic messages. Further, older college students

reported even stronger typing skills: only 2 percent indicated that they could not type at all. Nonetheless, a few applications of electronic text that were field tested require minimal to moderate typing skills and this appeared to present a problem for a small percentage of students. This problem is discussed later in this chapter.

In trying to develop a student attitudinal map that is relevant to the adoption of electronic text, we began by asking about their basic values in selecting courses or a program of higher education. To get at this issue, we asked students to assume that they had 100 tokens. These 100 tokens could be assigned as they wished to a series of values, or, reasons for choosing a given course or school. Table 4 presents the average distribution of tokens by the students to values.

Table 4. Student Values In Choosing Courses And Schooling

Rank Order	Value	Average Number of Tokens Assigned To The Value
1.	Quality of Instruction	19
2.	Will Help in Getting A Job	16
3.	Cost (tuition fees, availability of loans, etc.)	15
4.	Direct Contact With A Teacher	13
5.	Exciting Learning Experience	12
6.	Social Benefits (meet friends)	9
7.	Convenience in Taking A Course	9
8.	Access To Resources (labs, library, etc.)	7
(N=292)		100

Table 4 indicates that excellence of instruction ranks above all other values, followed closely by vocational and economic considerations. There were only minor differences between males and females in the assignment of tokens; students from lower income households indicated a greater concern about cost than those from higher income households; and adult learners placed somewhat greater emphasis on vocational values - assigning approximately the same number of tokens to "Will help in getting a job" as "Quality of instruction." Also, students in a remedial college math class placed a stronger emphasis on "exciting learning experience" compared to other groups.

We also sought to assess student attitudes about electronic text prior to any exposure to the medium. This was approached in a series of steps, moving from the broad and general to the narrow and specific. First, we asked about their attitudes toward new technologies generally, as shown in Table 5.

Table 5. Student Attitudes Toward New Technologies In Education

Attitude	Percentage of Students
Very Receptive & Among The First To Try New Technologies.	32%
Open To Try New Technologies But Need To Be Convinced Of Their Benefit First.	60
Generally Skeptical But Will Go Along After Much Convincing	6
Very Skeptical And Will Avoid Them If At All Possible	2
(N=289)	100%

Table 5 indicates a general receptivity to new technologies in education by college students, though a strong majority want some evidence of benefit before leaping into new waters. There were few differences among sites on this question, but some male-female differences emerged. A higher percentage of males (36 percent versus 26 percent) were very receptive to new technologies and wanted to be first in line to try them. Women fell overwhelmingly into the second category: open to new technologies but wanting some evidence of benefits to be derived.

A pattern of "cautious openness" is revealed as well in student attitudes about computers generally and electronic text specifically. Tables 6 and 7 present these patterns. In Table 6, students were asked whether the descriptive word on the left applied to computers. They responded on a five point scale, with 5 indicating that the word applies most of the time and 1 indicating that the word applies to computers almost never.

Table 6. Student Descriptive Words For Computers

Descriptive Term	Average Student Rating
Useful	4.5
Efficient	4.3
Helpful	4.3
Powerful	4.1
Valuable	4.1
Interesting	4.0
Complex	3.8
Exciting	3.5
Overwhelming	3.2
Frustrating	3.1
Scary	2.3
Isolating/lonely	2.0
Dangerous	1.7

(N=82)

Table 7 presents student attitudes about electronic text prior to using it in their courses. Their responses are based upon a verbal description of electronic text as a general service.

Table 7. Student Attitudes About Electronic Text Prior To Using It.

Attitude	Percentage of Students
Interested And Want To Try It	75%
Not Interested/ No Appeal	7
Undecided/ No Opinion	18
(N=288)	100%

The patterns presented in Table 7 were reasonably consistent among the sites. Finally, we assessed the degree of student interest in specific electronic text services prior to any use of electronic text in a course. Here too, student responses are based upon a verbal description of the services. Table 8 presents the students' attitudes.

Table 8. Degree of Student Interest In Specific Electronic Text Services Prior To Using Electronic Text.

Service (Rank Order)	Strong Interest	Moderate Interest	Weak/No Interest
Information That Is Part Of A Course	+		
Access National Databases	+		
Access Campus Databases	+		
Access Library Card Catalogue	+		
Information About Campus Social Activities		+	
Electronic Mail Between Students & Instructors		+	
Health Information		+	
Educational Games			+
Electronic Mail Student To Student			+

(N=292)

Table 8 suggests that student interests in electronic text services, based upon a verbal description, are strongest for course related information, national database information, campus databases and library card catalogue information. These responses were reasonably consistent among the sites and among the demographic variables that we examined. Table 19 (page 32) presents student interest in specific services after using the electronic text course materials.

These baseline patterns indicate a potential need for electronic text services and a general readiness to make use of them. Against this background, we then attempted to gain

some measures of learning effectiveness and attitudes after using electronic text.

2.2 LEARNING FROM ELECTRONIC TEXT

We tested a few different forms of electronic text (e.g., high-end and low-end graphics) under different conditions (e.g., use at home and use on-campus) and with different types of students (e.g., adult evening students, remedial math students, and typical four-year college students). We did not attempt to test all possible combinations of electronic text systems, usage conditions and types of students. Rather, we weighed and balanced what was possible to test at a given field site against the importance of the research question for the Annenberg/CPB Project and the availability of research findings from other sources on relevant issues. Our goal was to fill some of the gaps in knowledge and add to the evidence about the effectiveness of electronic text as a learning tool. Below, the conditions at each field site are described.

2.2.1 Nebraska. In Nebraska, two modes of electronic text use were tested with an evening marketing class of adult students. In one mode, electronic text as a supplement to classroom instruction, students were divided into two groups: Group A received classroom instruction alone and Group B received classroom instruction plus electronic text. In a second mode, electronic text as a supplement to print, students were also divided into two groups: Group C received print-based instruction alone (a traditional correspondence course experience) and Group D received print-based

instruction plus electronic text (a new correspondence course experience). All of the instruction covered the same topic areas. The electronic text components utilized high-end NAPLPS graphics and were used by students on-campus. All of the students received the same examination. Table 9 presents the results.

Table 9. Nebraska Marketing Course

Course Mode	Test Results Percentage of Questions Correct
Classroom Only (N=10)	84%
Classroom + Electronic Text (N=14)	85
Print Only (N=10)	80
Print + Electronic Text (N=12)	88

While the classroom group with electronic text scored higher than the classroom only group, the results are not statistically significant. However, the new correspondence course mode of print plus electronic text yielded significantly better test scores than the traditional mode ($T = 2.01$, one-tailed, $p \leq .05$). Further, the student group in this evening class is very much in tune with the general characteristics of the target audience for Annenberg/CPB.

2.2.2 Wisconsin. In Wisconsin, two test sites were employed. Both involved students enrolled in a core political science course at a four year college. At the first field site, the instructor integrated the Annenberg/CPB supported telecourse, Congress: We The People, into his on-campus course. Here, the research question was whether electronic text materials could enhance the learning provided by the telecourse and the instructor.

The electronic text course materials utilized low-end ASCII text and inexpensive user terminals. Table 10 presents test scores for the electronic text students and a control group. All students received instruction from a face to face instructor, video telecourse materials and a print study guide.

Table 10. Wisconsin Political Science Course: Site 1

Treatment Group	Test Results Percentage of Questions Correct
Electronic Text Group (N=17)	65%
Control Group (N=5)	56

(T = 1.72, one-tailed, p ≤ .05)

The electronic text group achieved higher test scores than students who received the same telecourse and classroom instruction without the electronic text enhancements. In addition, within the electronic text treatment group, students gained access to the materials in different ways. One subgroup received the material at home through a national videotex service. A second subgroup received the material on-campus through the same national videotex service, and a third subgroup accessed the materials on-campus through a stand-alone personal computer. Differences in their test scores are noted in Table 11. While these test score differences are not statistically significant, they do provide some useful indicators. Moreover, there were important differences in the way these subgroups used the electronic text materials as well as in their attitudes about them. These differences will be discussed later in this chapter.

Table 11. Wisconsin Political Science Course: Site 1 Electronic Text Subgroups

Electronic Text Mode	Test Results Percentage of Questions Correct
National Videotex Service Accessed at Home (N=5)	66%
National Videotex Service Accessed On-campus (N=5)	62
Personal Computer Emulation of Videotex Accessed On-campus (N=7)	67

At a second Wisconsin test site, electronic text was compared directly with classroom instruction. In this situation, as at the first test site, a core political science course integrated the Annenberg/CPB supported telecourse CONGRESS: We The People within the campus based course. Students were divided into two groups. In one test group, students received the telecourse video materials, print study guide and electronic text materials (the instructor was present but absented himself from instruction about the telecourse materials). In the other group, students received the telecourse video materials, print study guide, and classroom instruction - with no electronic text. Table 12 indicates that a face to face instructor in combination with the video telecourse yielded better test scores than electronic text in combination with the video telecourse. This suggests that electronic text is not a replacement for a classroom instructor, though it can serve as an alternative when a regular classroom instructor is not available.

Table 12. Wisconsin Political Science Course: Site 2

Group	Test Results Percentage of Questions Correct
Telecourse + Instructor (N=75)	69%
Telecourse + Electronic Text (N=74)	65

($Z = 1.83$, one-tailed, $p \leq .05$)

2.2.3 Boston. In Boston, we examined electronic text as a tool to provide remedial math instruction for college students in need of such assistance. Here, students from two math courses who were experiencing difficulty were advised to seek remedial help. After they presented themselves for assistance and agreed to participate in our project, their level of knowledge in the subject areas to be covered by the electronic text lessons was pre-tested. The students then worked through a series of electronic text lessons over a period of a few weeks. Following this, they received a post-test.* The electronic text system used to create the lessons contained high-end NAPLPS graphics capability, which was used extensively. Students accessed the lessons on-campus.

Table 13 presents the students' test scores before and after they worked with the electronic text remedial math lessons. It indicates that the students significantly improved their test scores after working through the electronic text lessons.

* Our original design called for a control group of students who would utilize existing print materials for remedial assistance. However, this group shrank to a very small number and was not useful for comparison.

Table 13. Boston Remedial Math Group

Test Group	Test Scores Percentage of Questions Correct
Before Electronic Text Instruction (N=21)	70%
After Electronic Text Instruction (N=21)	84

(T = 4.11, one-tailed, $p \leq .01$)

Taken together, test scores from the field sites are very encouraging. Electronic text instruction yielded statistically significant and positive results as a remedial tool, as an enhancement to a telecourse, as a stand-alone correspondence course and as an enhancement to classroom instruction. Electronic text did not yield better results as a direct substitute for a face to face classroom instructor.

While the test scores are very encouraging, they should be interpreted conservatively and cautiously. Our evaluation was modest in scope and the findings should be assessed along with other available research. With this caveat stated, the results provide positive evidence in support of the argument that electronic text can be an effective educational tool.

2.3 USAGE CHARACTERISTICS

There is a good deal to be learned about the design and implementation of electronic text instruction based upon how students actually use electronic text materials. We examined usage from a few perspectives and in some depth. Our sources of data included survey responses, diary records, direct observation

and system-based measurement of usage.

2.3.1 Session Length. Looking broadly across all the field sites, an average instructional session (i.e., one in which a student used one or more of the formal lessons) ranged from 52 to 84 minutes in length. A strong majority of students (67 percent) felt that the session length they experienced was "about right." However, approximately one fourth of the students felt that session lengths were too long. Many of these students said that sessions longer than one hour produced some eye strain and general fatigue. Direct observation of selected student sessions supported these reports. This suggests that the design of electronic text materials and the implementation of instructional services should allow students to complete a given lesson or designated assignment in a one hour session (or less). Further, students might be advised about eye fatigue from long sessions and encouraged to avoid very long sessions (e.g. end-of-the-semester cram sessions) at the terminal.

At one site in Wisconsin some students used electronic text at home while others used it on-campus. Both of these groups could send/receive electronic mail and engage in computer conferencing on topics as well as use the designed instructional materials. Here, session length and other usage characteristics differed from field sites elsewhere. Further, differences between home and on-campus usage were noteworthy. It is useful to examine these usage patterns in more detail. Tables 14, 15 and 16 present the usage patterns of the home and on-campus groups in terms of session length, number of sessions and total time per week, time of day usage and day of the week usage.

Table 14. Home & On-Campus Usage: Session Lengths And Number of Sessions Per Week

Group	Per Week
HOME VIDEOTEX (5)	
Total Time	3:41
Number of Sessions	8.7
Average Session Length	:26
ON-CAMPUS VIDEOTEX (5)	
Total Time	1:02
Number of Sessions	2.2
Session Length	:29

Table 15. Home & On-Campus Usage: Time of Day

	Time of Day						
Group	am 6-9	9-12	12-5	5-7	7-9	9-11	11- pm
HOME VIDEOTEX (5)							
N Sessions	25	40	70	67	60	46	29
Total Minutes	182	479	1549	1412	2024	1632	914
CAMPUS VIDEOTEX (5)							
N Sessions	0	33	14	0	6	0	0
Total Minutes	0	1180	416	0	11	0	0

Table 16. Home & On-Campus Usage: Day of Week

Group	Mon	Tue	Wed	Thu	Fri	Sat	Sun
HOME VIDEOTEX (5)							
N Sessions	37	44	35	23	31	29	34
CAMPUS VIDEOTEX (5)							
N Sessions	11	9	13	8	7	0	0

MULTISESSION DAYS

Home Videotex	60 percent
Campus Videotex	19 percent

Several patterns emerge from the data in Tables 14, 15 and 16. First, the home group used the electronic text service more than the on-campus group - more individual sessions and more total time. The home group also used the service over a more diverse time frame - some used it very early in the morning while others used it late at night, and, many used it on weekends as well as weekdays. Not surprisingly, the on-campus group used the service within a more narrow time frame, i.e., weekdays during normal school hours. In addition, the home group had many multisession days - they entered the service more than once a day. These multisession days were often related to electronic mail: students checked-in to send or receive electronic mail in one brief session, then entered the system later to do lessons. Thus, the home group had much more variation in length of session - some were long and some were short. Associated with

these patterns of use, the home group liked the service better and scored somewhat higher on the subsequent exam. This suggests a potential value in home usage of electronic text where it is feasible. In the home, a student has more flexibility and can integrate the electronic text into diverse study and daily living habits.

2.3.2 Becoming Comfortable With A Terminal. One of the claims made for new electronic text systems is that relative to general computer applications, electronic text is easy to use. Table 17 indicates at our field sites the electronic text systems were indeed relatively easy to master. Of the students surveyed about this issue, only 7 percent required more than 2 hours of use before they gained reasonable comfort with the system and only 1 student failed to achieve comfort in usage. It should be noted that at most of the sites, many forms of assistance or help were available, e.g. an initial training session, printed instructions and a person who could be summoned or telephoned if a student encountered problems. Indeed, a clear lesson learned

Table 17. Time Required To Gain Reasonable Comfort In Using The Electronic Text System.

Time To Gain Reasonable Comfort	Percentage of Students
Under 1 hour	71%
1-2 hours	21
2+ hours	7
Never Gained Comfort	1

(N=114)

in the project is that such early assistance is invaluable in getting students started. Also, it should be noted that there are at least two stages on this system usage learning curve. There is an initial period of learning enough about the system to use it with comfort (what we assessed) and a longer period of mastering the system. It would appear that an on-campus user group can achieve the first stage of comfort more readily since a "helping" person can be made available (e.g. a computer lab assistant or a librarian). However, the home group in Wisconsin (who did receive a face to face training session) experienced few problems. Further, they felt that they were at an advantage. As one student commented,

> "I believe it is easier for home users to get used to the system than those who worked out of the (on-campus) lab. At home, the terminal is easily accessible and you can do the necessary 'playing' with the system when you have a few spare moments. The only way to learn to use the system is by hands-on playing with the system."

2.3.3 Technical Problems. A related usage issue is the technical problems experienced by students. Overall, the students reported few technical problems. Some students experienced difficulty in logging-on to the national videotex service and occasionally this system "crashed" or cutoff a student during the middle of a lesson. Also, a few students complained about glare on the screen from overhead ceiling lights.

2.3.4 Qualitative Observations. Direct observation of students using the terminals at some sites revealed a series of important qualitative issues. These may be grouped under a few categories, as described below.

- The "naming" of instructional elements and system features appears to influence students' expectations about them as well as their use of them. For example, a student role-playing exercise may be called a "game" or a "simulation", each leading to different expectations. Further, an instructional designer cannot assume (at this point) any knowledge of computer terminology in providing online instruction to new users. For example, some students commented, "what's 'routing'" on seeing this term on the screen.

- Students are quite impatient with any delays or slowness in an electronic text system. They want screens to display quickly and files to be found instantly.

- Students look for and need "resting places" during an electronic text exercise. In reading a book, a student can "rest" at the end of a chapter, a section or even a page. Further, students can easily place "markers" at resting places, e.g. by folding the corner of a page. Students look for similar stopping points in electronic text. However, sometimes there are few easily recognized stopping points or, perhaps, students have not yet developed comfortable, personalized ways to place markers in the electronic text when they want to take a break.

- Students want to work at their own pace, go forward or backward at will, and generally to "control" the electronic text materials. This appears to be associated with reading levels as well as a feeling of controlling a system versus being controlled by it. Electronic text systems vary a great deal along these dimensions. Also, some systems are intolerant of mistakes such as pressing the wrong key.

- The combination of working on paper along with using a terminal (e.g. in the remedial math lessons) appears to work rather well. Some types of instructional exercises are well suited to paper and pen - everything does not have to be online.

- The social space where a terminal is placed will bring with it certain unwritten 'rules' of appropriate conduct. These in turn can influence student attitudes toward and use of the electronic text terminal. For example, in Boston the terminals were located in a lower level room of the media center. It was an informal casual space. Many students in turn brought a candy bar or soda with them as they used the terminal. The informal atmosphere appeared to foster a positive attitude and reduce potential anxiety about the "new machine."

2.4 ATTRACTIVENESS

We attempted to assess student reactions to electronic text materials in a few ways. In one survey question, students were asked to indicate their agreement or disagreement with a series of statements. Table 18 presents their responses.

Table 18. Student Ratings Of Electronic Text Materials

Statement	Strongly Disagree	Disagree	Unsure/ Neutral	Agree	Strongly Agree
The Electronic Text materials were easy to use.					X
I learned a lot from the Electronic Text materials.				X	
The time it takes for information to appear is too slow.			X		
The graphics made the materials more attractive.					X
The graphics added to the learning experience.				X	
It would have been better to use the Electronic Text materials at home.			X		
Using Electronic Text provides a learning experience you can't get from a textbook alone.					X
The materials helped to stimulate interest in _____.				X	
Quiz questions & other interactive features of Electronic Text are good.					X

(N=67)

Female students rated the electronic text materials slightly higher than male students. In addition, students who used electronic text instructional lessons plus "extra services" such as electronic mail rated electronic text slightly higher than those who used the instructional lessons without the extra services. This may indicate that a package of services has more attraction than a single instructional component (chapter 4 explores this issue in greater depth). Further, services with high-end graphics received somewhat higher attractiveness ratings than those with low-end graphics. However, the issue of graphics is complex. Table 18 indicated that students clearly liked the graphics but were a bit less in agreement about the learning outcome associated with graphics. Some on-site observations and interviews in the Boston testing may help to illuminate the issue.

The WGBH remedial math package contains a number of high-end NAPLPS graphics. Certain uses of graphics clearly provided educational content, e.g., color coding to separate concepts or visual movement on the screen to illustrate mathematical processes. Students liked these forms of graphics and appear to have learned from them. Other forms of graphics served as a reward or reinforcement for correct answers. A strong majority of students liked these graphics very much and commented about them during our face to face interviews as well as in open-ended survey responses. Apparently, this group of students has received negative feedback about their performance in math for many years. So, the graphics served a counter-balancing role. However, a

minority of students felt that the 'reward' graphics were superfluous or juvenile. There is yet a third type of graphics which served no specific educational function but merely enhanced the visual 'look' of a section. Often, these appeared at the beginning of an instructional segment much as a drawing may appear on the opening page of a chapter in a textbook. Students had few comments about such graphics but they may have had a subtle influence on the overall appeal of the electronic text (students rated it very high).

These responses to the WGBH high-end graphics can be interpreted in a few ways (the use of graphics in electronic text generally is a much debated topic since there are costs associated with the creation, transmission and terminal display of high-end graphics). It may be argued that the responses support the following generalizations:

- Where graphics serve a pedagogic as well as an attractiveness function, e.g., when graphics visually communicate a concept, they are clearly valuable.
- Graphics in 'reward frames' appear to be appropriate for some groups, e.g., remedial students, but they may have a negative impact on some students. They should be used sparingly and perhaps reduced in quantity as lessons progress.
- Graphics that enhance general attractiveness of materials are appropriate and useful at selected points in the lesson, e.g., a title frame for a section. However, they too should be used sparingly.

Students were also asked what they liked best and least in the electronic text materials that they experienced. Qualities that received multiple mentions are described below.

Liked Best

interactivity
self-paced work
realism of simulations
communication with other students and instructor
graphics

Some comments were associated with a specific site and related to a particular objective of the production group. For example, a number of the Boston remedial math students said that the materials helped to reduce their anxiety about math (this was a specific objective for these materials). A few students in the Nebraska test group said that they had sharply changed their views about marketing (in a positive direction), including two who said that they now intended to pursue a career in marketing. A number of Wisconsin students commented that the electronic text simulations allowed them to understand what it is like to be in Congress by going through the exercises and making decisions like a Congressperson.

Liked Least

slowness of system
sessions too long
couldn't backtrack easily
system intolerant of mistakes

Here too, many of the comments were site specific. Some students did not like the essay questions in the Nebraska materials (these responses appear to be due, in part, to weak typing skills of those respondents). In Wisconsin, one mode of electronic text delivery - a videotex emulation on an Apple Computer - was criticized as slow in displaying frames. In Boston, some

students felt that the system was too unforgiving if they made a mistake in entry (i.e., hit the wrong key).

2.5 STUDENT WANTS IN FUTURE ELECTRONIC TEXT SERVICES

Having experienced electronic text in one or more forms, students were asked what they wanted from future services and what they regarded as the strongest potential uses for electronic text in higher education. Table 19 outlines the degree of student interest in potential services after their experience in an electronic text course. These responses may be compared with those in Table 8 which presented their degree of interest prior to experiencing electronic text.

Table 19. Degree of Student Interest in Specific Electronic Text Services After Using Electronic Text.

Service (Rank Order)	Strong Interest	Moderate Interest	Weak/No Interest
Access National Database	+		
Course Registration	+		
Information That Is Part Of A Course	+		
Access Library Card Catalogue	+		
Access Campus Database	+		
Electronic Mail Student to Student		+	
Electronic Mail Between Students & Instructors		+	
Educational Games		+	
Health Information		+	
Information About Campus Social Activities		+	

(N=90)

In general, students indicated a moderate to strong interest in several services. There were many site-related and demographic differences in responses. For example, students tended to show greater interest in those services they actually experienced. Thus, students who experienced electronic mail indicated greater interest in it than those who did not experience it. Overall, male students showed a slightly greater degree of interest in services than female students. More specifically, women indicated greater interest in course-related information, health information and course registration compared to men; women indicated less interest in social information, educational games and electronic mail compared to men. It may be argued that these patterns suggest an interest by female students in services with a clear and immediate functional purpose.

Students were also asked an open-ended question about strong potential uses for electronic text in higher education. Their responses included both broad categories of use as well as smaller details about what they want from a specific service. The broad categories of strong potential use that received multiple mentions included:

- self-paced learning;
- learning at home;
- supplements to classroom instruction;
- simulations;
- access to information outside the campus.

The tone that ran through these responses emphasized "functionality," i.e., ways that electronic text could enhance their education. The specific qualities students indicated as highly desirable in electronic text services reinforce some of the findings from earlier survey questions. Highly desirable qualities included:

- easy to use;
- convenient to use;
- excellent instructional content;
- versatile system (i.e., a student can go back and forward and move through the content in individually tailored ways);
- small discrete units (i.e. a student can use the materials in small chunks, stopping when they want);
- fast display of frames
- good, utilitarian graphics

The tone that ran through these responses is "tailored to individual needs." Our direct observation of students using electronic text materials revealed much variability among students in reading levels and ability to concentrate over a period of time. Some students worked through electronic text content for an hour or more without stopping while others took breaks every 10 minutes. In addition, we noticed a curious phenomenon of students 'talking to the screen.' In some instances this involved speaking out loud what they were reading on the screen. However, more frequently it involved verbally responding to something on the screen, e.g., "That's neat.....Oh, that's how you do it.....what do I do now." At one level, the phenomenon appears to be a form quasi-social interaction: treating the machine as if it were a person. However,

a more refined explanation for this curious behavior will require further investigation.

2.6 ACCEPTABLE PRICING LEVELS FOR ELECTRONIC TEXT

The willingness of students to pay for electronic text services as well as how much they are willing to pay are difficult questions. In the long term, this must be assessed by offering services at given price levels and measuring interest and resistance. Nonetheless, we tried to gain some understanding of willingness to pay. Chapter 3 describes a program of laboratory studies that addressed the issue in some depth. Our field evaluation, described in this chapter, addressed the issue in a more limited way. In the field, we tried to get at the pricing question by asking students at two sites (Boston and Nebraska) to estimate their willingness to pay for electronic text services in a future course.

Students were asked to go along with a scenario in which they wanted to take a course next year. They learn that the course has a number of direct and indirect costs associated with it: tuition, textbook, other books and print materials, electronic text and transportation to college each week. In this scenario, electronic text was presented as a supplement to classroom instruction. Students were then asked to provide two estimates for each cost category: a/ a reasonable and acceptable cost; and, b/ an upper limit and painfully high cost that might lead them to reconsider taking the course. Responses by the two groups differed sharply, owing perhaps to differences in existing

education costs in Boston and Lincoln, Nebraska. Table 20 presents the responses.

Table 20. Student Estimates of Acceptable and Painfully High Costs for Electronic Text and Other Education Fees Associated With a College Course.

Cost Category	BOSTON (N=21) Acceptable Cost	Painfully High Cost
Course Tuition	$ 380	$ 600
Textbook	37	60
Other Required Books	18	40
Required Electronic Text Software	163	298
Transportation Cost Per Week To & From Class	*	12

Cost Category	NEBRASKA (N=27) Acceptable Cost	Painfully High Cost
Course Tuition	$ 111	$ 179
Textbook	24	39
Other Required Books	12	24
Required Electronic Text Software	18	38
Transportation Cost Per Week To & From Class	7	16

* A few students appear to have answered this question on the basis of a full semester's transportation costs rather than per week. Therefore, the mean response is omitted.

Rather than try to account fully for the variability between responses from Boston and Nebraska students, it may be wiser to accept that pricing for electronic text is uncertain. Further, it may be more useful to note how students place electronic text vis a vis pricing for tuition, textbook, etc. rather than to

highlight absolute dollar figures alone. For example, measured against tuition, students in Nebraska indicated that an acceptable price for electronic text might be 16 percent of tuition cost. Table 20 does not consider pricing for electronic text in a stand-alone mode, e.g. a correspondence course. Nor does it consider electronic text as part of general student activity fees per semester. Chapter 3 will examine the latter question.

3. LABORATORY STUDIES

Our research program included both formative and summative evaluations of electronic text applications in higher education. Simulation laboratory studies were an important part of the formative evaluation. While these laboratory studies differed in the evaluation questions they pursued, all shared certain characteristics.

3.1 BASIC CHARACTERISTICS OF THE SIMULATION LAB STUDIES

The simulation laboratory studies were conducted at the Center for Communication, San Diego State University. In simple terms, we used microcomputers to imitate electronic text services for higher education, services which in reality would require large minicomputers or mainframes, intricate computer programming, and extensive communication channels. By "simulating" electronic text services on a small computer, the reactions of potential adopters and users of such services could be systematically studied. Such electronic text simulations were of short duration; all simulations lasted less than one hour. By measuring knowledge, attitudes and behavior both before and after simulations, changes resulting from the simulation were analyzed.

An example of an electronic text simulation illustrates both strengths and weaknesses of this approach. Suppose that a university is considering the development of an "electronic syllabus" text service. This system would permit students, using home terminals or kiosks in public locations, to examine

the syllabi of various courses before enrolling in them. Would students use such a service? Would they pay for such a service? What characteristics of students would affect their decision to adopt or reject such a service? These are important questions that a college administrator would likely want answered before engaging in the expensive and time-consuming process of actually implementing such a service.

Using a small microcomputer and relatively simple computer programs, the evaluator can create a fictitious "Electronic Text Syllabus Service." The simulation would include only a few course syllabi and would provide simple procedures for viewing these syllabi on the terminal. Potential users--students--could then use (or view a demonstration of) the "Electronic Text Syllabus Service." Users could be asked questions both before and after the simulation to determine the impact of exposure to such a service on their interest in the service, their willingness to pay for it, and so forth.

3.1.1 Strengths of Simulation Studies. Simulations of electronic text services, such as the syllabus example above, have several strengths as evaluation tools. First, they are relatively inexpensive. A service that would literally require hundreds of hours of programming to fully implement on a campus-wide basis can be simulated on a microcomputer in a fraction of the time and at a fraction of the cost. Further, such simulation studies permit strict experimental or quasi-experimental controls, thus allowing the evaluator to identify cause and effect relations. For example, does the speed of the service, i.e., the time it takes to display a given frame of information after it has been

requested, affect adoption or rejection by the user? In a simulation laboratory study, speed of the system can be systematically manipulated to test its impact on users. In a field setting, using a fully implemented electronic text service, such isolation of causes and effects is much more difficult to achieve. As such, lab simulations of electronic text provide a useful tool in the formative evaluation of such services.

3.1.2 Weaknesses of Simulation Studies. Lab simulations have several weaknesses as an evaluation tool. A major difficulty is that simulations of electronic text services occur out of context. Potential adopters are asked to evaluate electronic text services under controlled conditions in a laboratory setting. This setting differs from the subject's home or the campus library where such services are likely to be available. Further, the simulation experience is brief--less than one hour. As such, all reactions to these services represent reactions of initiates. Attitudes and behavior over longer periods of usage can only be inferred from these brief episodes of use. Such initial exposures may generate high levels of enthusiasm that may not be sustained over longer periods of use. Finally, some electronic text services simulated in the laboratory are not currently available outside the lab. So subjects must be asked to project their future adoption and use, should such services become available. As such, proxy measures often must suffice when the actual behavior of interest cannot occur.

3.2 PRODUCTION-BASED LAB STUDIES

One goal of our formative evaluation efforts was to provide quick responses to production questions about electronic text. These narrowly defined research questions were posed by electronic text producers to help make design decisions. Both qualitative and quantitative techniques were used.

Two such production oriented studies were conducted. The first study involved the use of diagrams and narratives in electronic text to communicate information. The purpose here was to conduct the research in a relatively short time frame and quickly feed the results back to the producers to help them make a production decision. Subjects were 54 students at San Diego State University; the subject matter was information about stocks and bonds. Both diagrammatic and narrative presentations were used to present information. Retension and comprehension were measured. Findings from the study helped the producers decide when to use diagrams and/or narrative to present information.

The second study involved a test of the value of a "self check" electronic text package. The "self check" was used by students taking a mechanical engineering course at San Diego State University. Students read a chapter in the course text, then were tested on the material covered. Students then used a hard copy version of the "self check" electronic text package which supplemented the mechanical engineering course. Students were tested again to help producers "fine tune" the package.

Students also evaluated colors, shapes, and lettering used in the package by examining color photos of electronic text screens.

The findings of these studies were specific to the situations for which the research was conducted and need not be reported here. While such studies contribute little to cross-situational generalizations or theory, they are invaluable to producers seeking a rational basis for making certain design decisions. While all members of the Consortium were invited to use the production-oriented lab services of the San Diego State evaluation unit, few requests for such services were made. Discussions with Consortium members indicated that turn-around time and geographical separation reduced the usefulness of this formative evaluation service. It is also possible that the Consortium members need to work together for a longer period of time in order to bring this type of service into their production schedules.

A related and important finding of the production-oriented evaluations was the value of qualitative techniques. Specifically, electronic text simulations on a microcomputer (or photographs of electronic text screens) served as useful stimuli for focus group discussions. This technique, i.e. focus groups with electronic text simulations as stimuli, is especially appropriate in formative phases of electronic text evaluation.

3.3 THE DEVELOPMENT AND TEST OF THEORY

While production-oriented formative evaluations are valuable to specific producers faced with specific design questions, they do not build theory that can be applied across situations. Further, they do not address the types of questions that planners,

administrators and other researchers find useful.

A series of simulation studies were conducted to provide generalizations about electronic text that could be applied to a wide variety of situations and settings. These studies sought to develop and/or test theory about the adoption and use of electronic text. Four major research questions were pursued in two large-scale experiments using simulations of electronic text. These studies are reported in more detail in other Consortium publications. Major questions and findings are summarized here. The four research questions addressed were:

1. The impact of electronic text demonstrations. Prior research indicated that demonstrations of electronic text services greatly increase a person's willingness to pay for such services. However, these prior findings are based on studies of commercial videotex services appealing to the general public. Do demonstrations of electronic text which support narrowly defined educational services have the same impact on a narrowly defined population? A replication of prior research was conducted to determine if generalizations from prior research applied to electronic text services in support of higher education.

2. The "critical mass" theory. The critical mass theory was stimulated by a fccus group study in 1982. The theory states that in order to overcome an individual's inherent resistance (or threshold) to adopting an innovation like electronic

text, the benefits must outweigh costs of adoption. If the services available on an electronic text system are too few in number, electronic text is likely to be perceived as not worth the "cost," either financially or cognitively, of adoption. At some point, the number of services offered on a system exceeds the resistance level of the adopter. By varying the number of services available on an electronic text system, the critical mass theory was tested and partially confirmed.

3. The use of graphics. An important issue for administrators and planners to tackle is the use of graphics in electronic text systems. The inclusion of color and graphics in an electronic text system increases the cost of system hardware, increases production costs, and delays somewhat the speed with which an electronic text screen can be displayed on a terminal. A simulation experiment provides evidence that, under certain circumstances, graphics substantially increase the value and adoption of electronic text services.

4. The distant learner and barriers to adoption. Perhaps the most valuable finding of the simulation lab studies involves distant learners. Electronic text can provide important services to distant learners and thereby bring higher education within reach of many who would otherwise not have access. Therefore, distant learners were expected to find electronic text services of greater value than other students and were hypothesized to be willing adopters. Our lab studies provide evidence supporting this hypothesis, but only after the effects of a student's age are taken into account. These findings

have far-reaching practical implications for introducing distant learners to electronic text.

Each of the four research issues posed above are considered in detail below.

3.4 HOW ELECTRONIC TEXT DEMONSTRATIONS AFFECT ADOPTION

Adoption of electronic text means that an individual student decides to acquire an electronic text terminal and use these services to pursue his or her college education. In the lab simulation studies, students were asked to project their adoption of such services if and when they become widely available. There are many ways to project adoption of electronic text. Perhaps the best measure developed in our lab studies involved asking students how much they would pay for such services if they were made available. Specifically, students were told that a portion of their student fees could be allocated to fund a student electronic text service at their university (San Diego State) and asked: how many dollars should be paid each semester for these services? Electronic text services that support higher education were first briefly described to the student. The student was then asked to project their personal adoption of such services, using the measure outlined above. The student then saw a demonstration of several electronic text services on a microcomputer. Following the simulation, the student was again asked how much he or she would pay through student fees for electronic text services.

The results confirmed findings of prior research on commercial videotex services. That is, a significant increase

in projected adoption occurred as a result of a direct demonstration of such services. On the average, students (N=92) were willing to spend $27.23 a semester for electronic text services, based on a brief description prior to the demonstration. Following the demonstration, the average increased $8.50 (31%) to $35.73.

The implications are quite significant when administrators and planners seek to stimulate adoption and use of electronic text during the early stages of implementation. As with any complex technological innovation, the value that individuals place on that innovation is closely tied to their comprehension of the technology and reducing their fears of its complexity. The Times-Mirror Gateway commercial videotex system in southern California takes advantage of the power of such demonstrations to sell its services to potential customers. While college administrators who implement electronic text services at colleges are not "selling" electronic text to students, rapid adoption of such services is likely necessary to justify costs and accrue benefits to the university. The planned use of electronic text demonstrations to stimulate student (and faculty) adoption is a useful strategy for guiding rapid adoption.

3.5 THE "CRITICAL MASS" OF THE SERVICE PACKAGE

There are many ways to configure an electronic text service package to support higher education. An electronic text system could be developed for a single application, such as an electronic messaging service to link students, faculty

and administrators at a single university. At the other extreme, a university could implement a complex electronic text system with access to an extremely large number of services on-campus and, through gateway links, to off-campus services as well.

The critical mass theory has two parts: an individual adoption component and a system design component. For an individual, adoption of electronic text services may involve direct out-of-pocket expenses for a terminal and usage fees. Just as important, the individual must learn how to use this new technology efficiently in order to receive any benefits. The "learning curve" required to comprehend and adopt a complex technology can be properly viewed as a "cost" of adoption, just as real as the cost of obtaining a terminal.

In order to overcome inherent resistance (threshold) to adoption, the electronic text system must offer sufficient rewards in terms of services to make the cost acceptable. Some believe that there is a key or decisive electronic text service, which does something special for the individual unavailable elsewhere, that will stimulate adoption among substantial numbers of students and faculty. The critical mass theory rejects this notion. Rather, individual electronic text services are viewed as being of insufficient value by themselves to justify the cost of adoption. Only when a relatively large number of such services are bundled together on a common system does the critical mass of services exceed the individual's threshold of adoption. Some individuals will value some services more than others, but--generally speaking--no one service is decisive.

The use of the "critical mass" metaphor becomes obvious when this adoption theory is considered at the institutional level. College administrators and planners seek to accomplish several goals through the implementation of electronic text systems. They seek to make numerous campus communication/information activities more efficient and less labor intensive. They seek to make college services available to potential students (distant learners) who might not otherwise seek a college education. Providing information and conducting transactions over an electronic text system has a number of substantial fixed costs (software development, communication hardware, operations and administration) which are accrued whether the services are used by a few hundred students and faculty or by tens of thousands. Thus, the decision to implement electronic text services and to commit substantial resources to its basic operation rests in part on the assumption of rapid adoption of services by large numbers of the academic community.

Once the basic hardware/software system is in place, and once a large user population has been created, the marginal cost of adding new electronic text is low and the "payoff," in terms of utilization, is immediate. As such, the interaction of individual adoption and institutional level expansion of services creates a chain reaction. As more services are added, more people adopt electronic text. As more people adopt, the more cost-beneficial it becomes to add new services.

The most important issue posed by the critical mass theory is: how many services are needed to reach critical mass? The

simulation experiment reported here cannot answer this question. Rather, an intermediate question is answered: does the projected adoption of electronic text increase as a linear function of the number of services offered? Perhaps the addition of new services to an electronic text system may not increase projected adoption. Perhaps the increase in perceived benefits of adoption start to flatten out for the potential adopter after the first few services. If that is so, the addition of new services increases costs for the institution without providing increased benefits to the institution through increased adoption. Under these circumstances, the chain reaction will never occur.

To examine this, 12 student-oriented electronic text services were shown to a sample (N=93) of students at San Diego State. These services included electronic syllabi, electronic bookstore, electronic library services, electronic box office, electronic discussion groups, electronic student records, electronic student newspaper, and others. Each service package was demonstrated briefly. Students were randomly assigned to five groups and measures of projected adoption (as described above) were made at different points in the simulation. One group projected adoption of the package after a brief verbal introduction, i.e., without exposure to any of the electronic text services on the simulator. The second group projected adoption after exposure to three electronic text services. (The order in which services were presented was rotated in order to control for the differing levels of value associated with each service.) The third group projected adoption after exposure to six electronic text services.

The fourth group projected adoption after exposure to nine electronic text services. The fifth group projected adoption after exposure to twelve electronic text services.

These results show a strong linear pattern: increasing the number of services increases projected adoption, at least up to 12 services. Prior to seeing any services, students were willing to spend $27.23 a semester for electronic text services. After exposure to three electronic text services, average willingness to spend per semester was $30.00 After exposure to six electronic text services, students were willing to spend an average of $33.52. After exposure to nine services, average willingness to spend was $29.33. Average willingness to spend jumped to $35.72 after exposure to twelve electronic text services. Despite the dip in projected adoption after exposure to nine services, the general linear increase in adoption due to the addition of services is confirmed. (The correlation coefficient is .76, indicating a strong linear relationship.)

More research is needed to determine the point at which increased adoption is not affected by the addition of new services. However, the general finding that projected adoption increases linearly with the addition of new services has important implications. College administrators who implement a minimal electronic text service as a pilot test are likely to find low levels of adoption and undesirable cost/benefit outcomes. This would be misleading, however, because it ignores the interaction of number of services provided, the level of consequent adoption

and the marginal costs of adding new services to an electronic text system widely adopted by faculty and students. The range and number of available services in the system's initial configuration may have profound implications for the ultimate success or failure of electronic text.

3.6 THE USE OF GRAPHICS

The use of graphics in electronic text is as important to college administrators and planners as it is to commercial videotex operators. If graphics are not important, college planners could implement a text-only system consisting of letters, numbers, and the special characters found on the typewriter keyboard. Such a system could use inexpensive terminals; would lower production costs (a screen or frame with graphics takes longer to design and produce); and would provide the most rapid display of information on the terminal screen, for any given rate of transmission. If graphics are deemed important, a more sophisticated graphics protocol is required in order to transmit and display high-resolution graphics. This protocol requires relatively sophisticated terminals; increases production costs for those screens requiring graphics; and prolongs the time required to "build" a screen or frame on the user's terminal whenever graphics are used.

The importance of the graphics question led the project's evaluation team to explore complementary paths of research in the lab and the field (see section 2.4 for a treatment of field research on graphics issues). In addition, the lab research

built upon an earlier study at the Center for Communication in which subjects were asked to compare different versions of electronic text screens. One version contained text only. The second screen contained the same information enhanced through graphics. Three such paired comparisons were made. Researchers concluded that graphics are preferred only when they communicate information (e.g., an electrical wiring diagram) not effectively communicated with words. Decorative graphics that communicate no useful information were not preferred. With some qualifications (noted in section 2,4) our field research supported the same conclusion.

Our lab studies pursued this issue one step further and examined the relationship between graphics and willingness to pay for services. In a study of 256 college students, sophisticated graphics were used to communicate information via electronic text that could not be handled effectively through words. One application of graphics was demonstrated through the "Electronic Box Office" service. This service demonstrated how students could purchase tickets electronically to an on-campus, reserved seating theatre. The electronic text simulator displayed a detailed seating diagram of the open air theatre, then flashed a colored rectangle at the student's seat location. Other instructional support simulations were also tested. Following the simulation, students were asked to place a value on the graphics they had seen.

If willingness to pay is a valid indicator of projected adoption, the use of graphics significantly increases adoption

of electronic text services. On the average, students were willing to add an additional $5.71 to their $21.52 fee per semester in order to get graphics, a 27% increase. Fully 85% of the students felt that graphics enhanced the electronic text services. When asked specifically if they would pay an additional $10 per semester for graphics, 36% said they would.

This study has a few implications. It may be argued that implementing a text-only system reduces the attractiveness of services and may negatively impact projected adoption. Certain types of information cannot be effectively communicated through the written word. This is especially important when electronic text systems distribute instructionally-related materials requiring schematics, diagrams and illustrations. Further, the presence of some graphics appears to add perceived value to the service: users are willing to pay more.

3.7 DISTANT LEARNERS AND ELECTRONIC TEXT

Perhaps more significant than any other finding from the laboratory simulation studies is the willingness to adopt electronic text services among distant learners. Distant learners are defined here as those potential college students separated by distance and other circumstances (handicaps, child care constraints, etc.) from access to campus. Because distant learners have difficulty exchanging information and conducting transactions face to face on campus, they were hypothesized to project higher levels of adoption of electronic text services than non-distant learners.

It is reasonably well established that some categories of activity or demographic characteristics of people are

associated with greater or weaker predisposition to adopt electronic text services. For example, prior research on electronic text indicates that age is a powerful demographic predictor of electronic text adoption. Specifically, young people are generally more likely than old people to adopt electronic text. This generalization holds true even when other powerful predictors (e.g., hands-on computer experience and use of automated teller machines) are held constant.

To study this issue of distant learners and adoption, students (N=93) were asked how far they lived from San Diego State University. Distance was taken as a valid indicator (though not the only indicator) of distant learning status. We hypothesized that the greater the distance from campus, the more the student would value (and adopt) electronic text services that reduced the need for on-campus visits. Projected adoption was measured as willingness to pay. (Students were told that any long distance phone expenses would be borne by the university; telecommunication costs were controlled as a factor impacting adoption.)

Upon initial examination of student responses, distant learners differed little from non-distant learners in their willingness to adopt electronic text services. While there was a slight trend for projected adoption to improve as distance from campus increased, this increase was not statistically significant. However, further analysis indicated that students living next to the campus were younger than those distant from the campus. Those living within two miles of campus averaged

21 years; those over 10 miles from campus averaged 27 years. The reason for the initial findings became clear: the age of distant learners served as a significant barrier to adoption which offset the advantages that electronic text offered. What happens when the influence of age is removed statistically? Distant learners are much more likely to adopt electronic text services than non-distant learners. Removing the confounding influence of age, willingness to adopt was recomputed. Students living within two miles of campus were willing to pay $21.03 a semester for electronic text services. Students living 3-10 miles from campus were willing to pay $22.78. Students living more than 10 miles from campus were willing to pay $37.65 per semester, 57% more than non-distant learners.

Findings from this study are limited to distant learners already enrolled in college. These were the subjects of study in the simulation experiment reported here. Further research will be required to determine if they apply to a broader group of distant learners, including those who are not currently attending an on-campus college program.

The implications of this study are subtle but important. While the distant learner has perhaps the most to gain (greater relative advantage) from the adoption of electronic text services, these potential adopters also possess high barriers to adoption. These are frequently older students who possess demonstrated higher levels of resistance to electronic text adoption. The two countervailing forces may cancel each other out. However, the

findings from the study also suggest a strategy to deal with this potential problem. That is, careful use of electronic text demonstrations and special sensitivity to the high adoption thresholds of older students can overcome this problem. The data indicate that older students are just as likely as younger students to increase their willingness to pay (and, by inference, their willingness to adopt) for electronic text services as a result of electronic text demonstrations. Metaphorically, distant learners have higher barriers to overcome in order to adopt electronic text. Once they pass over this barrier, however, the distant learner is likely to be an enthusiastic and heavy user of electronic text services in support of higher education.

3.8 IMPLICATIONS

The laboratory studies provide evidence that the projected adoption of electronic text services steadily increases as new information services are added to the system. This pattern of linear increase holds for the addition of up to 12 new services (we did not test beyond this limit). This has implications for the design of electronic text services, especially when institutional-level concerns of college planners and administrators are taken into account. Specifically, college administrators should avoid the temptation to "pilot test" a scaled-down version of a university electronic text service for purposes of conducting cost-benefit analysis.

If the findings of laboratory simulation studies can be applied to a natural field setting, the level of adoption of

a minimal electronic text service is likely to be disappointing. However, levels of adoption of a minimal service are not truly indicative of levels experienced when a more extensive package of services is offered. The interplay of the initial size of the service package, the level of adoption, and the marginal costs of adding new services must be carefully considered. While this study cannot specify what the critical mass of services might be, this study does suggest that such a critical mass does indeed exist.

The laboratory simulation studies also provide evidence that high quality graphics, when used to communicate effectively, can substantially increase the perceived value and projected adoption of electronic text services. Certain types of information cannot be communicated effectively by words alone. The extra communicating power of high resolution graphics is perceived by potential adopters as valuable and the effective use of graphics affects projected adoption.

Finally, the laboratory simulation studies provide evidence about the function and impact of electronic text demonstrations themselves on adoption decision making. The importance of electronic text demonstrations is recognized by commercial videotex operators. Those implementing electronic text services in higher education can learn from these private operators in this regard. The demonstration of electronic text services increases projected adoption in part by reducing the student's perception of electronic text as excessively complex. This increase in projected adoption as a result of a simulation experience holds for older students--who generally show higher resistance--as well as younger

students--who are generally more likely to adopt. This finding is very important for those seeking to aid distant learners through electronic text. While the distant learner has perhaps the most to gain from electronic text use, these more mature students also possess higher initial resistance to adoption of electronic text. The electronic text simulation can serve as a powerful aid in overcoming these barriers to use.

4. THE HIGHER EDUCATION MARKETPLACE: OPPORTUNITIES AND BARRIERS FOR ELECTRONIC TEXT

In one sense, higher education is a marketplace much like the consumer marketplace or the corporate marketplace. Here, issues of cost and pricing, institutional values and agendas for development, and existing organizational structures can present opportunities and barriers for electronic text. Our assessment of higher education as a marketplace begins by examining how colleges are currently using electronic text, their plans for developing new services and characteristics associated with colleges who are strong candidates to adopt electronic text.

4.1 ELECTRONIC TEXT SURVEY OF COLLEGES

A 31 item survey was sent to approximately 300 colleges and universities throughout the U.S. to ascertain their current utilization/predisposition to adopt electronic text services and other associated technologies. Specifically, the survey was designed to determine (a) their utilization of word processing, self-paced instruction, electronic mail, and electronic text; (b) their predisposition to adopt electronic text systems for student services and/or instructional offerings; (c) the decision-making processes that would be involved in adopting electronic text systems on their campuses, as well as the potential points of resistance; and, (d) their perceptions of the technology as a potential enhancement to instruction.

A stratified sampling of university and college campuses was employed to insure the inclusion of the following groupings: (a) publicly and privately funded institutions; (b) advance degree-granting institutions, four-year institutions and community colleges; (c) large campuses and small campuses; (d) liberal arts oriented institutions and science or technically oriented institutions; and (e) independent campuses and ones belonging to multi-campus systems. Balanced geographical representation was also sought. Questionnaires were mailed to the Vice President of Academic Affairs for each institution in January 1985. A total of 94 completed questionnaires were returned*.

4.1.1 Status of Electronic Technologies Utilization. When asked if their institutions utilized electronic text systems, 38 percent of the campus representatives claimed that theirs did not, and 62 percent claimed that their campus did use some form of electronic text system. Of those institutions with such a system, 81 percent utilized it for general student services, 85 percent for instructional purposes.

All of the campuses in the survey reported having word processing systems; 52 percent indicated that they had self-paced

* Among responding institutions, 58 percent were publicly funded and 42 percent were privately funded. 75 percent of the campuses were doctoral degree-granting institutions; 15 percent were master's degree-granting institutions; and 10 percent offered a bachelor or associate of arts degree only. The majority of these campuses (53 percent) could be described as equally balanced between liberal arts and science orientation; the remainder were divided in roughly equal percentages among liberal arts, science or a "professional" orientation. Enrollment characteristics of the respondents were: 33 percent, under 5,000 students; 47 percent, 5,000 to 20,000; and, 20 percent, over 20,000 students.

instructional systems; and 63 percent reported having electronic mail capability. Generally speaking, these electronic mail systems are for administrative use, less so for faculty use; the self-paced instructional systems were reported to be utilized by the institutions for various instructional purposes, mainly at the lower division level. All of the campuses surveyed offer courses in computer use and/or computer language. However, none of them require their students to have personal computers at home for use in specific classes.

4.1.2 Predisposition To Adopt Electronic Text Services. The campus representatives were asked a few questions about their institutions' predisposition to adopt electronic text technology if they did not already use it. When asked if their university or college had contemplated electronic text services, 45 percent of those responding reported affirmatively and fifty-five percent negatively.

Respondents were asked if they could envision the technology in the student services component of their universities and how it might be utilized. Forty-four percent indicated such applicability and specifically pointed to its use in registration, library services, and information dissemination (e.g., availability of courses, housing, jobs, financial aid and directory data). Only 18 percent could not envision such an application; 28 percent, however, were uncertain.

Among those responding to this series of questions, 39 percent could envision the applicability of electronic text to instructional contexts, while 14 percent reported that they could not, and the remaining 47 percent indicated that they

were uncertain. Specific applications were suggested for a variety of disciplines by the respondents, including library science, mathematics, history, linguistics, computer science, economics and the hard sciences.

4.1.3 Diffusion of Electronic Text Service Concept. When asked if instructional processes might be compromised or enhanced by two-way computer-based modes of instruction, the campus representatives responded in the following way. A group of 47 respondents indicated that instructional processes would be enhanced if the interactive computer-based instruction were utilized selectively (as a supplement, not a replacement for traditional instruction), and if the particular technology employed were "user friendly." This group also said that it was very important for a high level of human interaction to be maintained between professor and student. In addition, they suggested that the technology be used for self-paced learning with immediate feedback, to support flexible scheduling, and for competence-based situations. A second group of 29 respondents indicated some concern about cost factors, the potential for reduced human interaction between professor and student, and user fatigue or boredom. Most of those responding to this inquiry with negative comments also reported some positive reactions. The key concern about the technology which surfaced among many respondents revolved around any potential threat to professor-student interaction.

Respondents provided a variety of answers to a question about the decisionmaking process that would be involved in their

institutions' adopting electronic text technology. Many indicated that such a decision would involve some type of feasibility study and/or a special task force committee. Others said it would involve consensus building by groups of affected parties. Still others suggested that it would be tied into a decision-making process through the vertical structure of faculty and administrators. When asked about possible points of resistance toward the new technology, the respondents pointed to faculty primarily, then to cost factors, and finally to administrators and students.

The last part of the survey asked respondents to evaluate electronic text as a potentially widespread technology of the future. Thirty-eight of the respondents indicated that indeed they felt electronic text would be widespread in use, while 12 did not feel this would be the case. However, it is worth noting that as many as 24 campus representatives chose not to answer the question. The prevalence of "yes" responses to this question was equally divided by the representatives of the public and private institutions.

In general, the survey reveals relatively little use of the most recent electronic text services, e.g., home videotex instruction, but a great deal of existing applications in more traditional electronic text services such as computer-based instruction on-campus. Further, there appears to be moderate receptivity to the newer services, with some important qualifications as noted above. It should also be noted that there is a general operational "fuzziness" about electronic text services and

what they entail. This uncertainty is likely to continue for some time.

4.1.4 Selected Case Examples of Utilization. Upon completion of the analysis of data from the survey, an attempt was made to follow up with telephone interviews to those institutions with the greatest current use of electronic text technology. Four universities in particular were found to fit within this category: the University of Michigan, Brown University, the University of Missouri and Gallaudet College. Descriptive examples of their activities are presented below.

- The University of Michigan utilizes electronic text technology through electronic conferencing with approximately 1,500 to 2,000 users in psychology, linguistics, education and law classes. It is used more for general communication than for class-related instruction. The two electronic conferencing systems on campus are Confer and Forum. These systems are available to anyone who can access them. Electronic text technology is also employed at the University for registration, the course catalogue and library services.

- Brown University utilizes electronic text technology primarily as a messaging service, with Computer Science and Engineering majors using the system most frequently. In addition, the Mathematics Department employs electronic text to supplement classroom instruction.

- The University of Missouri uses electronic text for scheduling and messaging, on a limited basis. Computer Science graduate students use the Profs System to interact with their teachers through electronic calendars and electronic mail; this function is independent of classroom activity.

- Gallaudet College employs electronic text in a manner similar to the University of Michigan. The English Department utilizes the technology for student-teacher conferencing. As is the case for the other three universities, such text interaction takes place through home as well as campus-based access to the host system.

4.2 ECONOMIC ISSUES

A second set of nuts-and-bolts marketplace issues is related to economics. In this section, an emphasis is placed on videotex (i.e., electronic text transmitted over a telephone wire) and associated costs for a student-user as well as a university-system operator*.

4.2.1 User Costs. The cost of using an electronic text service may involve direct charges for using the service itself (on a per hour, per month or per semester basis), telephone and data network charges, and the costs of equipment to receive the service as well as software necessary to make use of a particular electronic text standard. Most of these charges can be incurred by videotex users. The following discussion examines these costs individually and describes some of the ways in which they can be kept within feasible boundaries.

Currently, the most complex and variable cost in a videotex service is for the telephone connection between a user's terminal and the system's host computer. Telephone connection charges include those for local phone service (which vary by region and whether the customer has timed or untimed monthly service), long distance charges if any, and data network connection charges if any.

Factors to be evaluated when considering the cost of videotex for student users include the location of students (i.e., their distance from the host computer) and the rate structure that

* For a more comprehensive treatment of economic issues see John Carey, An Economic Assessment of Electronic Text. San Diego: The Electronic Text Consortium, Report Number Six, 1984.

will apply to the telephone lines used by students to connect their terminal to the host computer. For an identical amount of monthly use, the same educational videotex service may cost different student users widely divergent amounts, depending on where they are located, the time of day they use the service, and how they connect to it. In this sense, student telephone costs in a given area may render videotex a viable service or one that is not economically feasible.

There are a few significant ways to help reduce the costs of telephone service associated with videotex. These include: a/ use the service during evening hours or on weekends when rates are less expensive; b/ employ downloading techniques where possible; and, c/ place some of the electronic text content on floppy diskettes that can be sent through the mail or purchased in bookstores. Downloading techniques (b above) involve sending content in a "big batch" that is recorded and stored by the user, typically in a personal computer. The user then hangs up the telephone and works with the electronic text "offline" without any further telephone costs.

A user has two choices, under most circumstances, for equipment to receive videotex. These are a dedicated videotex terminal or a personal computer that is adapted in order to receive videotex. Electronic text services can be accessed by a broad range of personal computers with the addition of a modem and appropriate software. One advantage of using personal computers to receive videotex is that they are more versatile than dedicated terminals. PCs can be used for stand-alone processing

in addition to access of electronic text services and can record downloaded software for offline interaction (which, as discussed above, is an important way to help reduce the cost of electronic text services).

The main advantage of using dedicated videotex terminals is their relative simplicity (no extra software is needed to receive the service). However, these terminals have no storage capacity, nor any computing functions outside those provided by the service itself. Until recently, some commercial videotex service could be accessed only by a dedicated terminal. However, all of the major services now have (or will soon have) a software package enabling personal computers to receive their service.

Table 21 below presents cost estimates for three types of videotex receiving equipment from low-end to high-end cost. In each case, the total cost of the equipment package is listed. However, for those students who already own a personal computer, the cost of adapting it for videotex use would be lower.

Table 21. Typical Videotex Terminal Prices

Category	Price Range
Low-end Personal Computer (e.g., Commodore 64) for ASCII or NAPLPS videotex/	$300 to $500 (includes computer, modem and software)
NAPLPS stand-alone terminal (e.g., SCEPTRE)	$600 to $900 (can also be rented)
High-end Personal Computer (e.g., Apple IIe or IBM PC) for ASCII, Prestel or NAPLPS videotex	$1,500 to $3,000 (including computer, modem and software)

4.2.2 Service Provider Costs. There are three general standards for videotex currently in use within the U.S. These are: 1/ ASCII; 2/ World System (Prestel); and 3/ NAPLPS. With each of these systems there are two major categories of equipment cost for a service provider: a/ frame creation equipment, and b/ host computer equipment. In addition, there is a third category of system cost - software to operate the host computer and manage the electronic text content.

Frame creation equipment for an ASCII service is relatively straightforward. Any personal computer capable of receiving ASCII text can also create text for an ASCII service by drawing on the software support of the host computer. The two other electronic text standards require specialized frame creation equipment. For World System (Prestel) text services, costs of frame creation systems begin around $1,500 for a software package which adapts an Apple IIe to Prestel graphics, to increasingly sophisticated systems costing from $3,500 to $15,000. There is a similarly broad spectrum of costs for NAPLPS frame creation systems, from $2,000 to $5,000 for software packages that run on a personal computer to advanced graphics terminals (e.g. AT&T, Norpak and Sony) in the $25,000 to $40,000 price range.

The cost of a host system for videotex varies in relation to the standard employed (e.g. ASCII versus NAPLPS), the storage and processing capacity of the system, and the number of users served. Since there are so many variables here, it may be most useful to provide general ballpark estimates only and to describe

some key elements that will affect the cost of a host system. First, there are some situations where there is no need for a host system. A college or other higher education group creating content that will run on a commercial videotex system does not need a host computer; frame creation equipment will suffice. Second, there are many small applications that can piggyback on existing equipment. For example, an individual professor who creates ASCII electronic text content for his or her own class may be able to place the content within existing college computing facilities at relatively low cost. Moving up in scale, a college department that seeks to create and offer electronic text content for a few classes may be able to purchase a low-end host system with telephone ports for $15,000 to $20,000. The Center for Communications at San Diego State University tested such a system as part of its activities for the Electronic Text Consortium. On a college-wide or regional level, a host videotex system can vary widely in cost, from $50,000 to $250,000 or more. The key elements affecting cost are the number of students to be served and whether the service will require new, dedicated computer hardware or if it can reside within an existing campus mainframe computer. On a national level, a major videotex system is very expensive: $10 million to $100 million, which includes a complex array of mainframe and minicomputers to manage files. This latter scale of service is clearly out of the range of most educational institutions' budgets.

Another cost consideration for service providers is the cost of obtaining and maintaining system software. Software costs are dependent on such factors as: a/ whether off-the-shelf software is used or whether user-specific software must be developed; b/ whether software is leased or purchased; and c/ the extent to which on-campus expertise (e.g., from the campus computer center or computer science department) can be utilized to develop, install and maintain software. A major problem at the moment is the lack of good, off-the-shelf software packages that are appropriate for educational videotex.

Production costs associated with creating electronic text content are related to staff size which in turn is related to the amount and type of content that is to be created. Section 5.2 treats staffing issues. These can be used to generate estimates for local production staff costs.

4.2.3 Trends That Are Likely To Affect Costs. A number of developments are anticipated that will likely offset some of the costs associated with providing electronic text in higher education settings. One is the growth in the number of personal computers among students and faculty. Our survey in this project as well as surveys by other groups suggest strong growth in the next few years. This growth, when added to an existing strong base of personal computer ownership by students (15 percent in our survey), can reduce the "cost of entry" for a student to electronic text. That is, electronic text can be introduced as a value-added service, and hardware costs need not be attributed

to nor borne by the services themselves.

Related to this growth in the population of personal computers is that of local area networks (LANs) on campuses. Local area networks are essentially cables installed throughout a campus to interconnect computers at very low cost (special software is also required to manage the local area network). While the growth rate for LANS on college campuses is not yet clear, they offer a strong potential to decrease the cost of on-campus electronic text services by bypassing telephone connections to the host computer.

A third development which can help to lower the cost of videotex services is local area data transports (LADTs). LADTs are offered by local telephone companies. They provide inexpensive connect time to videotex services in a regional area. For example, an LADT in southern Florida allows Viewtron users to connect to that service for $1 per hour telephone charge.

Collectively, these economic issues imply that <u>local</u> electronic text services will be very important for low cost higher education applications. This is not to argue that the placement of higher education materials on some national videotex services is not viable. Rather, it is to argue that higher education should not depend principally upon the current generation of national videotex services to serve students. In many cases, a college-based or regional electronic text service is likely to be more feasible from a cost perspective.

4.3 POTENTIAL BARRIERS

Three potential barriers to the widespread use of electronic text in higher education will be treated here: general reports and some research findings that women have less interest in computer-based services than men; problems associated with the implementation of new services with a strong technology component; and, potential faculty resistance to electronic text.

4.3.1 Women and Electronic Text. There have been many reports which appear to indicate that women use computer-based services less than men. One national survey of households with a personal computer (Gannett Survey, October 1984) revealed that adult males used the computer more frequently than adult females by a ratio of 3:1. This differential was almost as strong for male and female children in the households. In other situations, e.g., information terminals placed in public locations such as a library or the lobby of an office building, similar patterns of greater use by males have occurred (NYU/WETA TV teletext trial in Washington, D.C.). At the same time, there have been some counter examples. In Minnesota, a state with extensive computer training in the public schools as well as the highest ratio of computers to pupils among all states, female students are reported to hold the same interest as males in computer-based learning, at least through grade school. Similarly, in the field testing of the Electronic Text Consortium materials, women used the electronic text as much or more than males and rated it a degree or two higher than males. Yet, in spite of

their usage and apparent interest, a lower percentage of women students owned a personal computer (19 percent of males versus 9 percent of females) and a lower percentage of women students indicated an intention to buy a personal computer in the next few years (40 percent of males versus 26 percent of females).

How can these conflicting patterns be explained? Our research does not provide an answer. However, it does provide a few clues about elements that may influence usage and attitudes. First, the gender of those who create software may be a factor. It is argued that much commercial software is created by males for males. And indeed, 85 percent of those creating commercial software are reported to be males (The Wall Street Journal, 4/29/85, p 27). In the work of the Electronic Text Consortium, there was approximately equal representation by men and women in the content production teams. There is a suggestive association between this gender mix on the production side and the relative equality of usage by male and female students. However, the link is weak from a research perspective.

A second clue relates to role models. At each of the Consortium sites, one or more women played a prominent and public role in introducing the materials to students. This may have conveyed a message about the appropriateness of the materials for women. It has been noted that commercial advertising tends to emphasize males as role models in using software. In this sense, the advertising may be conveying a message (and forming 'public knowledge') that computer-based

materials are the domain of males.

A third clue is associated with "functionality." That is, women respondents in our field site survey emphasized an interest in electronic text services that have a clear functional use in their lives. Further, the women respondents wanted some assurance that the use of electronic text will bring with it some benefits in their education. Males wanted functional services as well. However, a much higher percentage of males indicated that they were among the first to try new technologies, even before they are sure that the new technologies will provide benefits. In other words, many males are interested in exploring technology for technology's sake but females are interested in the functions that technology can serve.

4.3.2 Implementing New Technology Services. The field evaluation in San Diego encountered a few problems which are informative generally about the implementation of new services with a technology component. One test group for the electronic text consisted of engineers working at a private company. A security problem emerged, i.e., the company prohibited the use of "communicating computers" within their physical plant for uses such as extension education. In another application, electronic text to enhance a telecourse being used by advance placement high school students, two implementation problems emerged: a/ access time when students could use the terminal was restricted; and, b/ little or no assistance was available to students from their instructor if they encountered difficulty in using the electronic text. These combined to yield low usage.

Implementing new services such as electronic text requires a good deal of support, particularly in the period immediately after the installation of equipment. It is not sufficient to install the equipment and demonstrate how to use it once. Many layers of support (printed instructions, online help, a telephone hotline and, if possible, a helping person at the site) are required. Further, institutional requirements for security or scheduled access to parts of a building can have a negative impact on a new service.

4.3.3 Faculty Resistance. Faculty resistance to new technologies has been an issue in the development of many educational services. In some cases, faculty members have feared that they might be replaced by the new technology; in other instances, they have been concerned that they might look foolish in front of their students because they had not mastered the equipment; and in still other instances, bad experiences with earlier technologies (that didn't work or were ineffective) built up resistance to new technologies. In some ways, the term "faculty resistance" is a misnomer. Much of the resistance has involved the use of sound judgment and a concern for excellence in education.

At the Consortium field sites, relatively little faculty resistance was encountered. However, the evaluation team did not systematically investigate general resistance by faculty members and undoubtedly there was a natural selection process in which interested faculty members found the project directors and vice versa. Our limited investigation of this area did

reveal a few patterns that are noteworthy. First, it did not appear that faculty members viewed electronic text as a potential replacement for the classroom instructor or a threat to faculty jobs. They viewed it as a more modest service that would be adjunct to the faculty role. Second, faculty members are skeptical (correctly so) of excessive hyperbole about new technologies. The site directors were very careful in this regard, with positive results. Third, faculty members appear to value "control over instructional content" and want to adapt or integrate content within a course plan that they have designed. Electronic text offers this potential. Indeed, the electronic text materials created by the University of Wisconsin-Extension (and field tested in Wisconsin) have since been adapted for use in Alaska by local faculty in Alaska. This potential for local adaptation may help to overcome some forms of faculty resistance by allowing the local faculty member to become an "author" of the material.

5. TECHNOLOGY AND PRODUCTION ISSUES

This chapter treats selected issues associated with the technology required to offer electronic text services and the production staff to create content.

5.1 ELECTRONIC TEXT TECHNOLOGY

From a technical perspective, there are four principal elements that must be in place for an electronic text system to function. These are: the hardware system (computer and related equipment) that serves as a host for content; the software or computer programming that organizes content within the host system and interacts with users; the transmission system (e.g., telephone lines) that carries data to the end user and, in the case of videotex, from the end user back to the host system; and the end-user terminal that receives and sends data. Running throughout all of these is a fifth element: the software standard or protocol used to format content.

The Consortium members tested a number of system configurations, thereby allowing us to assess each of these principal components of an electronic text system.

5.1.1 Protocols: Definitions And Standards For Videotex. The definition of a videotex service has changed over the past few years. Originally, it appears that the term was intended only for those electronic text and graphics services in which content was organized into screens or frames of information and transmitted over telephone lines to home receivers designed specifically for videotex. However, in the U.S. this definition has never been a "working definition" since many electronic

text services calling themselves 'videotex' did not meet these criteria.

It may be more useful to classify generations of videotex systems in the U.S. Three such generations may be identified. The first generation of videotex systems was essentially database services with a few modifications to render them a bit easier to use. This generation of systems is still with us in the form of CompuServe, The Source and Dow Jones News Retrieval. They are black and white text-only systems. A second generation of videotex systems emerged with Viewtron in south Florida and Gateway in California. These systems provide frames or screens of content with color and high quality graphics. And, they were developed to serve dedicated terminals that could access videotex and do little else. A third generation of videotex system appears likely to emerge in the period 1986-1990. This generation will likely serve a broad variety of personal computers with simpler graphics and color. Already, the second generation systems appear to be shifting in this direction.

A critical feature of each videotex generation is the standard or protocol used to format content. There are two principal standards in use within the U.S., ASCII and NAPLPS*. ASCII (American Standard Code for Information Exchange), an early standard, is the simplest is appearance, consisting of plain alphanumeric text with neither graphics nor color. NAPLPS (North American Presentation Level Protocol Syntax), was developed

* A third standard, World System (or Prestel) is both available and viable but appears to have attracted little interest.

as a compromise between a few competing standards with color and graphics capability. NAPLPS has a variety of typefonts and can display electronic text and graphics in a broad array of colors as well as with limited animation. NAPLPS can be transmitted over telephone lines, like ASCII, or broadcast (in a broadcast mode it is usually called NABTS or North American Broadcast Teletext Standard). And, NAPLPS can be received through a dedicated terminal or, more recently, through a variety of personal computers adapted to receive it. However, there is currently more than one version of NAPLPS. This presents some problems, particularly for educational videotex applications, as discussed below.

The presence of more than one standard poses an immediate question of conversion or translation, either between NAPLPS and ASCII or between different versions of NAPLPS. Ideally, there would be a way to automatically convert content from one protocol to another, much as one can transfer a record onto an audio cassette. However, the problem is much more complex. While such automatic translation is not currently available, many groups are working on the problem and it is reasonable to expect some progress within the next few years. In the interim, an electronic text production group may have to create more than one version of a content package in order to "publish" it in many markets.

Within a given higher education context, e.g. a college, it is possible to create a "closed-user group" and specify the particular standard(s) that will be used. In this way, those

creating, storing and using content can adapt their frame creation equipment, host computer, and personal computer to the standard.

NAPLPS and ASCII need not be implemented exclusively of each other in educational settings. The two videotex standards can serve different educational purposes. ASCII, because of its simplicity and low cost to produce, is ideal for information that does not require graphics (e.g., reference or research information) or for communication services (e.g., messaging and teleconferencing) between students and faculty or among students. The enhanced qualities of NAPLPS (color, graphics and animation) make it suitable for much interactive instructional content, particularly when illustrative diagrams or charts are important. In this sense, a local videotex configuration at a college might contain both ASCII and NAPLPS.

5.1.2 System Configurations: Host Hardware and Transmission Systems. One of the first considerations for a college that is considering the use of electronic text is whether to rely on a commercial videotex system for the delivery of content or to develop a host system within the college. The weight of evidence appears to lean on the side of creating a local system within the college. This does not mean that commercial videotex systems are not suitable for some applications (they are) or that commercial systems will not become more attractive in the future (most likely, they will). This judgment is based in part on the Consortium's experiences with commercial videotex system operators. These operators are trying to attain economic viability and they do not regard education as the primary way to profitability. Therefore,

educational applications are treated, generally, with a secondary status. In addition, many of these systems are struggling to overcome poorly designed system architecture. New education applications with custom software requirements only add to the commercial operator's problems.

An alternative (though not mutually exclusive) solution is for a college or university to operate its own system. From a hardware perspective, this is a reasonable path to follow for many colleges. On many campuses, the necessary hardware is already in place or it can be purchased. A more problematic area is host software, as discussed in 5.1.3 below.

Transmission of electronic text has been subject to a great deal of testing and development. It is now technically feasible to deliver electronic text over a variety of transmission media including telephone lines, broadcast signals or coaxial cable. The principal issue for a college in choice of a transmission medium is not technical but economic (see section 4.2 of this report).

5.1.3 Host Software

The software that resides within the host computer and "operates" the videotex service is perhaps the most crucial element in system implementation and presents the greatest number of technical difficulties at the present. There is a need to develop appropriate host software for a higher education context. This does not necessarily mean creating entirely new software (this would be very expensive). More likely, it will require developing new and appropriate configurations of existing software

as well as working with commercial software vendors who may see an opportunity in the higher education market.

During 1984-1985, Consortium members explored the alternatives for host software systems and encountered many roadblocks. They investigated the availability of some commercial videotex system software, which is potentially adaptable for educational use, but were informed that this software was proprietary. These system operators were not willing to license their software for use outside their specific system. While some stand-alone software packages are available, they are not ideal and must be adapted for use in a higher education setting. Both WGBH and the University of Nebraska-Lincoln began this process of investigating options and adapting the more viable alternatives in order to support the field testing of materials they had created. However, a good deal more work is required.

The host software problem spills over and affects content development as well as dissemination. That is, in order for higher education groups to have an incentive to create instructional content and in order for colleges to see the content that is available, working college-based systems are needed. A reliable and economically feasible configuration of host system software is needed to move past this roadblock.

5.1.4 End-User Terminals. When videotex services were first introduced in the United Kingdom, an emphasis was placed on the use of dedicated terminals. This strategy was followed by some U.S. groups, e.g., Viewtron in south Florida. It is now clear that this strategy did not work. As a consequence,

most current and planned videotex systems have switched to a strategy that uses adapted personal computers as the end-user terminal. This is fortuitous for higher education applications of electronic text in that there is a large and growing population of personal computers among students and faculty. Further, a number of software packages have been introduced (or will be introduced in late 1985) to adapt a broad range of personal computers for use as videotex terminals. In this sense, the end-user terminal does not appear to be a barrier to the development of electronic text services in higher education.

In summary, a review of technology issues associated with electronic text and higher education indicates that,

- both ASCII and NAPLPS standards are appropriate, each for selected applications;
- many colleges seeking to offer electronic text services should consider operating their own system, as a way to avoid the problems associated with commercial systems and to manage all the "pieces" in a service through a closed user group;
- host hardware, transmission and end-user terminals for electronic text are both available and technically feasible;
- there are many options for frame creation equipment, but the presence of more than one standard may require production groups to create alternate versions of a content package if they wish it to be distributed widely on many different systems; and,
- the host system software is a missing piece in the technology configuration for local, college-based electronic text services (the need is greater for high-end NAPLPS host software than low-end ASCII host software).

In addition, many colleges are likely to require technical assistance in developing services. For some, this assistance may be available on-campus but for most it will probably mean technical support from external sources.

5.2 STAFFING AND MANAGING A PRODUCTION GROUP

From a production perspective, an analogy can be drawn between electronic text and printed text. The production or creation of print content for higher education covers a broad spectrum, from an individual instructor who prepares and mimeographs class notes for a course to print materials produced by a college to textbooks that utilize a team of artists, scholars and editors working under the umbrella of a national publishing house. So too, electronic text can span a broad spectrum of materials created by an individual instructor, a college and national production groups. The Consortium projects spanned this full spectrum, but somewhat greater emphasis was placed on the production of materials by a group, i.e. a college-based or national production group model. The treatment of production in this section examines issues associated with forming a production team and managing an electronic text service.

To get at these issues of staffing, training and management, a survey was conducted of 23 electronic text managers. The intent of the survey was to try to help those involved in developing new services by summarizing the experience gleaned on a variety of electronic text projects--commercial as well as non-profit--and by providing practical suggestions about how to get started*. Some of the results of the survey are discussed briefly below in relation to three main areas: 1/ time required to startup and train staff; 2/ how to assure service quality; and,

* For a more complete treatment, see Report Number Seven in the Consortium publication series, "Staffing and Training Requirements for Electronic Text Production."

3/ adapting to technological change.

5.2.1 Time Required To Startup A System And Train Staff. In general, the respondents to our survey stressed that starting up a system and training a group always takes longer than one would anticipate before beginning the process. A new service can be delayed by slow equipment delivery, bugs in system software, and the process of coordinating with internal administrative groups. Nevertheless, it may be reassuring to note that starting up a new electronic text service is much easier in 1985 than it was four or five years ago.

Although estimates varied, the consensus from our project managers was that it would be possible to set up a simple electronic text service within an eight week period. The time required to train new staff how to use an electronic text system is likely to vary in relation to the type of system, the background of the staff member, his or her facility with the equipment, and the task at hand (writing/editing or graphics creation). As might be expected, writer-editors take less time on average than graphic artists to gain reasonable proficiency with a system, due to the relative complexity of the tasks each must learn. The maximum training time for writer-editors is usually the minimum training time needed for graphic artists (e.g., whereas some writer-editors can learn a complex system in 1-2 weeks, it takes a minimum of 2 weeks for a graphic artist to learn a complex system). Table 22 presents a compilation of the estimates from our survey on how long it takes to train both writer-editors and graphic artists to use electronic text systems.

Table 22. Time Required To Train Writer-Editors And Graphic Artists On Electronic Text Systems.

Trainee Type	Writer-Editors		Graphic Artists (minimum time reqd.)	
	Easy System	Complex System	Easy System	Complex System
Fast Learner	1-5 days	1-2 weeks	1 week	2 weeks
Slow Learner	1-2 weeks	2 weeks or more	2 weeks	3 weeks

5.2.2 Assuring Service Quality. The electronic text managers in our survey cited a number of items as central to service quality. These include: teamwork, good staff communication, strong management and a maturation period for the product.

Teamwork is important throughout a project, and is even more critical during planning phases. Although many of the project managers felt that team members should be aware of each other's job functions, they also stressed that it is vital to clearly define areas of responsibility for each staff member.

In order to have strong teamwork, one must begin by hiring strong individual team members. Perhaps the most useful background for a general writer-editor is journalism, but there was some disagreement by survey respondents about what type of journalists (print, TV or radio) are best suited to electronic text. Regardless of background, the ability to "write tightly" and adapt material to the constraints of a screen (i.e., the amount of words that can fit on one display screen) is critical.

Graphic artists will under most circumstances be hired on the basis of demonstrated talent in print, but no one offered us any reliable way to predetermine which print artists are likely to blossom into excellent electronic text artists. There was a strong consensus in our survey that, in order for an electronic text project to function most efficiently, the individual(s) running the project should have a strong background in management. As important as background and skills are the attitudes of potential employees. The best staff for this often complex, new and changing medium will be versatile, innovative and open-minded. They will be able to take up the medium's inherent challenges without being overwhelmed by its problems and limitations.

The maturity of a service will affect how a staff spends its time and consequently the overall quality of the service. In the beginning, more time will be spent on planning, flowcharting and establishing a structure for the service. As the system and service develop over time, creative approaches to content can be explored and the needs of students addressed with more precision.

5.2.3 Adapting to Change. The constant state of flux in electronic text technology should be taken as a given and not viewed as an obstacle for managing a service. A number of approaches were suggested for adapting to the inevitable changes in hardware and software. One of these is to establish leasing agreements with equipment suppliers, rather than purchasing equipment outright. It is also important to inquire about

software updates and include updates in the original licensing agreement.

One of the implications of changing over to a new system is that staff will have to be retrained. Our survey indicated that this is not a major problem. It takes relatively little time to retrain staff on a new system, as when switching from alpha-mosaic to alpha-geometric. For both staff categories--editorial as well as graphics--the process of learning a new system should not take much more than a week, assuming that adequate training and documentation are available. Writer-editors may in fact require only a day or two to make the switch.

Finally, it was suggested that at least one member of the project team (e.g., the project manager) monitor developments in the technology and keep the rest of the project team informed about them as well as about anticipated changes in the project's system.

Throughout the survey responses and the many helpful suggestions by project managers there were no indications that the requirements for an electronic text service are beyond the capabilities of most colleges. Like print publishing, electronic text can be small scale and simple as well as large scale and complex.

6. CONCLUSION

This evaluation report began with a broad question: does electronic text make sense for higher education? Related to this was a series of component questions about the effectiveness, attractiveness and usage patterns associated with electronic text as well as economic, technological and institutional adoption issues. Our evaluation results suggest that the answer to the broad question is yes, while the answers to the component questions are generally positive with some important qualifications.

In order for electronic text to move forward in higher education, several 'pieces' must come into place. It must be demonstrated not only that electronic text is an effective learning tool but also that students, faculty and colleges are ready, willing and able to use it. Our field testing demonstrated that electronic text can be effective in several modes of use, e.g., as an enhancement to a telecourse, as a supplement to classroom instruction, as a stand-alone correspondence course, and as a form of remedial instruction. It served well as a tutor, a learning tool, a communication link to instructors, an access door to information on and outside the campus, and a simulator. Among its strong attributes were ease of use, self-paced learning, non-threatening learning and illustrative graphics capabilities. Electronic text is not a substitute for the classroom instructor but it is a potentially valuable adjunct to the instructor as well as an acceptable alternative under some conditions when a live instructor is not feasible.

Attractiveness to students was also demonstrated and many lessons were learned that can improve the attractiveness of future materials. An examination of usage patterns demonstrated some advantages to using electronic text in the home, although many on-campus uses are also appropriate. In addition, many details about session length and the implementation of services were identified. From a cost perspective, it appears that electronic text is viable, but particular attention must be directed toward managing transmission costs (e.g., telephone line charges for students accessing materials).

Our findings suggest that distant learners are more likely to adopt electronic text and that potential resistance based on age (i.e. older students showed more resistance to adoption than younger students) can be overcome if electronic text services are demonstrated effectively to students. Many higher education institutions appear to be generally 'ready' to make use of electronic text, but it will be very important to develop selective and appropriate applications, and to conduct vigorous dissemination activities since a number of colleges are confused about what these services offer. Further, many colleges are likely to need technical assistance in developing services.

From a technology perspective, the necessary hardware components to offer electronic text are already in place at many colleges and are available off-the-shelf for others who seek to develop services. The key piece of receiving equipment,

a personal computer, is already in the homes of 15 percent of students surveyed; an additional one third of students have easy access to one and many plan to buy a computer in the near future. This piece of equipment can be adapted at relatively low cost to receive electronic text.

In these ways, most of the pieces necessary for electronic text to develop in higher education are in place. What pieces are missing? First, the evaluation results lean towards local electronic text services, i.e., the individual college or a regional consortium acting as a small system operator. To do this, there is a need for more and better host software - the computer programming package that manages and runs the electronic text content within a college's host computer. Second, there is a need for more electronic text content development and effective demonstrations to colleges of the products that are available. Third, there is a need for practical assistance to help colleges develop services.

For an individual college, electronic text may be viewed as a value-added service. It can piggyback upon or extend the computer-based technologies and services they have been developing for a period of time. Like print technology, electronic text will likely involve a broad spectrum of services including some that are produced by individual professors, groups at the college itself, and national producers or publishers. Pursuing the print analogy further, a college can serve many roles in relation to electronic text: a producer of some content; a provider or

facilitator of content created locally as well as by national publishers; and a critical manager of standards and appropriate use.

For those who seek a broader role in developing electronic text as a tool for colleges and students, it is very important to distinguish development in higher education from commercial electronic text development. Commercial services have different objectives and must overcome a number of problems that are not associated with higher education applications. Further, some commercial activities have been characterized by excessive hyperbole followed by inevitable disappointment when unrealistic expectations are not met. It is critical that higher education applications of electronic text pursue a steady, realistic path of development.

From a research perspective, a number of issues have been uncovered that require further systematic investigation. Our laboratory studies indicated that a "critical mass" of electronic text services may be required to foster widespread adoption, but the size and composition of the critical mass is not clear. We made progress on issues associated with institutional adoption of electronic text but further work is indicated. In addition, some clues were uncovered about gender and the use of electronic text but the analysis is incomplete. Perhaps most important, there is a need for more communication with colleges about the practical findings from our evaluation, as well as those from other research groups, that can assist them in determining

whether to become involved in electronic text, at what level of involvement, and how to implement services that meet student needs.

APPENDIX MATERIALS

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ELECTRONIC TEXT CONSORTIUM PUBLICATIONS

Report 1. Electronic Text And Higher Education, by John Carey.

Report 2. Videotex Production: A Case Study, by Nancy Bamberger.

Report 3. Instructional Development For Videotex: Flowcharts And Scripting, by Gwen Nugent, P.J. Peters and Lee Rockwell.

Report 4. A Primer On Electronic Text Technology For College Administrators, by Philip Rubin.

Report 5. Videotex: Options For Libraries, by Merrie Appleman.

Report 6. An Economic Assessment Of Electronic Text For Higher Education, by John Carey.

Report 7. Staffing And Training Requirements For Electronic Text Production, by John Carey and Meryl Enerson.

Report 8. Assessing Electronic Text For Higher Education: Evaluation Results From Laboratory And Field Tests, by John Carey and David Dozier, with additional contributions by Jan Andersen, Martin Elton, Meryl Enerson, Kathleen Giglio, Susan Helweg, Philip Rubin and Alla Yefimov.

Monograph 1. Diffusion Of Electronic Text Among University Students And Faculty: A Strategy For Laboratory Research, by David Dozier.